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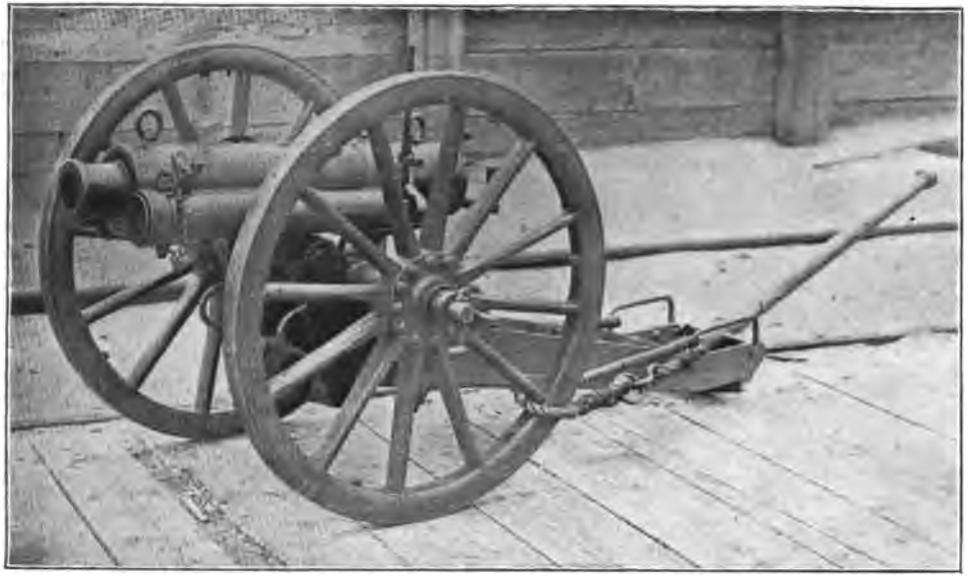

VICKERS-MAXIM 3-INCH MOUNTAIN GUN.

JOURNAL
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# THE MAXIM-NORDENFELT MOUNTAIN GUNS IN THE PHILIPPINES.

*Published by permission of the War Department.*

OFFICIAL REPORT OF CAPTAIN GEO. W. VANDEUSEN, 7TH ARTILLERY.

WASHINTON, D. C.,
April 23, 1900.

The Adjutant-General, U. S. Army,
Washington, D. C.

Sir:

I have the honor to report that, in accordance with Special Orders No. 217, Headquarters of the Army, A. G. O., 1899, I left New York City on the *S. S. St. Paul* on September 27th, 1899. Under the provisions of that order, it was intended that I should proceed to London, England, and superintend the shipment of certain mountain guns with their equipment, recently purchased from Vickers, Sons and Maxim Co., for use in the Philippine Islands, acquainting myself thoroughly with their use and construction from actual observation at the factory, and then to proceed to Manila and report to the Department Commander for duty in charge of said guns. I reached London on the 4th of October, and the next morning visited the office of the firm in London. I found, as anticipated, that the guns, with part of the pack equipment and ammunition, had already been shipped by a Japanese mail steamer to Hong Kong, having been inspected under the direction of the U. S. Military Attaché, Colonel S. S. Sumner. The remainder of the pack equipment would be ready for inspection in about ten days, while an extra order for ammunition would probably not be completed before the end of the

month. It seemed to me that there must be some error in connection with this order for ammunition on account of the very large proportion of case, 1800 rounds, such a number being largely in excess of any estimated requirements, and I desired Colonel Sumner to cable regarding the matter. He did not think it advisable, so I wrote a letter on the subject, trusting it might reach Washington in time to do some good in making any necessary change. On the 6th I went down to the Maxim-Nordenfelt gun factory at Erith, near London, accompanied by a representative of the firm. I was carefully shown all the details connected with the mountain gun, its mechanism, packing arrangements etc., every facility being given me to acquire any necessary information. The gun and mechanism were taken apart and assembled by employes, and then packed on the regulation pack saddle. After it had been explained to me, I took part in the work myself, and repeated it until I considered myself thoroughly familiar with all the details. On the 9th I repeated the same work, and later proceeded to Dartford to inspect the process of manufacture of the ammunition and fuzes, all the details of which were carefully explained to me. I was notified that the remainder of the pack equipment would be ready for inspection and packing on the 10th. On that date I made a careful inspection of the saddles, ammunition and boxes, and saw them packed ready for shipment on the Japanese mail steamer on the 13th. As the additional order for ammunition would not be ready for shipment before the end of the month, I did not consider that it was intended that I should delay in London for such a length of time, since the object was for me to reach Manila as soon as practicable and assume charge of the guns which had been already shipped. In order to gain time, I went by train to Genoa and there overtook a fast steamer of the North German Lloyd line, which had sailed from Southampton on October 9th, a day too soon for me to embark there, on account of the inspection of pack equipment on the 10th. I left Genoa on this steamer, the *König Albert*, and reached Hong Kong on November 15th. I had hoped to overtake the guns here, but upon visiting the U. S. Consul, Mr. Wildman, was informed that they had arrived a few days before, and had been transshipped at once to Manila, Gen. Otis having cabled that they were urgently needed there. I took the first steamer from Hong Kong, November 18th, and reached Manila on November 21st. I reported at once to the Department Commander, and was assigned to duty in charge of the guns, per S. O. 320, Headquarters Department of the Pacific and Eighth

Army Corps, November 21, 1899, but was informed that there was no immediate prospect of the guns being required for actual service, and that it would not be practicable to assign any men and animals to me at that time for purposes of drill and instruction. I was directed to submit as soon as practicable my estimate as to the number of men and animals requisite to properly equip each six gun battery, which I did the same day. I remained on duty in Manila, reporting daily at Corps Headquarters, and spending most of my time at the Arsenal, looking out for the guns and equipment. On November 30, I was instructed to prepare four of the guns, properly equipped, for shipment to Zamboango with the 31st Infantry, U. S. V. They were placed under charge of Major J. E. McMahon, 31st U. S. V. I., 1st Lieut. 4th U. S. Artillery, who detailed a company of the regiment in charge of them, this company being commanded by Captain Stivers, a graduate of the Military Academy of the class of 1879. The working of these guns has been most satisfactory, as is shown by a letter written me by Major McMahon. Up to the time of my departure, these guns had not been used in the field.

On December 8th I was ordered to take two of the guns by steamer to Vigan and transfer them to some officer to be designated by General Young to receive them. I left Manila on the steamer *Romulus* on December 8th, and reached Vigan on December 10th. By General Young's order, the guns were transferred to 1st Lieut. J. C. Lowenberg, 37th U. S. Vol. Infantry, formerly a first Sergeant of Artillery, and I gave him all possible instruction as to the use of the guns and ammunition. I have not received any direct report from him, but have been informed that he has had the guns in action under exceptionally severe conditions as to elevation and range, and that the results were more than satisfactory in every particular. I left Vigan on December 12th, and reached Manila on December 13th. On December 23d, I prepared one gun for shipment to Aparri, to accompany the 16th Infantry to that station, leaving only five of the guns in Manila under my immediate control. About noon on the 25th of December, I was sent for by General Schwan, and informed that Colonel Lockett was to go in command of an expedition against the insurgents at Montalban, near Mateo, and wished two of my guns. I was asked the minimum number of men necessary for the service of each piece, and said that there should be at least ten privates and two non-commissioned officers. A detail of this number was made from Battery E, 6th Artillery. I was also informed that as there was a road all the way and the

distance was not great, the guns could be hauled, and I would be furnished with one mule for each gun and a two-mule wagon for ammunition and rations. When asked to designate a lieutenant to go in command, I requested to be allowed to go myself, as I was very anxious to have some practical experience with the guns. I was ordered to proceed to the Pumping Station, about eight miles from Manila, that evening, and report to Colonel Lockett there. The men and mules reported to me at the Arsenal about two o'clock, and I prepared my ammunition etc., and left Manila at 3.30. Reached the camp of the 11th Cavalry about dark in a heavy rain, and was ordered by Colonel Lockett to remain there till morning and then proceed to San Mateo. Started on about 7 a. m. December 26th, and crossed the Maraquina River, the guns being ferried across on a small boat, mules and wagon fording. Reached San Mateo, about nine miles, at 11 a. m., and was informed that no further movement would be made until the following day. This delay enabled me to give the men of my detachments a little drill and instruction in the working of the piece, none of them having seen it until they reported for duty the evening before. The ammunition was carefully looked after and the guns cleaned and placed in perfect working order. At six the following morning, Dec. 27th, I proceeded to Montalban, about four miles, where the enemy was strongly intrenched on the side of a mountain, commanding the road and river. By Colonel Lockett's order, I placed my guns in a field at a distance of about 1500 yards from the nearest position of the enemy to cover the deployment of the Infantry. Fire was opened on the nearest trenches with shell, followed by shrapnel as soon as the approximate range was obtained, the fire being over the heads of the advancing Infantry line. As soon as this line was sufficiently advanced, my guns were moved forward to within less than a thousand yards and placed in a field where they could command the trenches on two sides. The enemy was soon dislodged from the nearest position and driven over the top of the mountain, being followed by shrapnel fire. The last shots against this portion of the enemy were at a range of 3200 yards, near the top of the mountain. At this range two shrapnel were exploded exactly in the spot from which the smoke of the enemy's rifles appeared as they fired. Not another shot was fired by this body of the enemy, nor was anything further heard from it. What the casualties were was not known as that part of the field was not visited later by our troops. About this time fire was opened on my guns from a field piece located in a gun pit about a thousand

yards away. Ten shots were fired by this piece before any effective range was obtained, and then one projectile was sent over my head. I then turned one of my guns on it and fired two shells. The second one silenced it for the remainder of the action. When the gun was captured later, it was found that the second shell had exploded within four feet of the piece, driving away the cannoneers so effectually that they never returned to the gun. This piece was being served under the charge of one Howard, a deserter from the California Volunteers and at that time holding the rank of Major of Artillery in the Insurgent forces. After silencing this gun and shelling the adjoining trenches until no return fire could be obtained, Colonel Lockett, who had remained with me up to this time, ordered me to withdraw my guns to the road in rear of my position and await further orders. While on my way back, I was met by the battalion adjutant of Major Brooke's battalion of the 46th Vol. Infantry, who had been sent to request Col. Lockett to send the artillery to the assistance of the battalion, as it was confronted by some strong intrenchments. I at once proceeded to the place indicated, and found the battalion deployed in a rice field about 500 yards from the nearest trenches. I took up a position directly in rear of his line, and opened fire upon two sets of trenches, at 500 and 800 yards. The fire of the guns at this range was very accurate, and five rounds at each range was sufficient to silence the fire of the enemy and drive them from the trenches, so that when the infantry advanced they were empty. In the upper one five dead Filipinos were found, killed by the last shrapnel burst over the trench. This was the last position of the enemy, and the work for the artillery was ended. I withdrew to the road, and later in the day to San Mateo. The next morning I returned to Montalban to be on hand in case the guns were needed, but there was no further use for them, so I returned to my camp at San Mateo. On December 30th I was ordered to return to Manila. Left San Mateo about 6.30 a. m. and reached Manila about 1 p. m. The ferry over the Maraquina river was under water, so that the guns were hauled through the river, the water being entirely over the guns. During this action fifty-eight rounds were fired, forty-eight shrapnel and ten shell. The action of the ammunition was perfect in every way, there being no misfires, and every round being exploded as required by the setting of the fuze or on impact. The recoil, even after continued firing, was very small, not more than a couple of feet as a maximum, with little derangement of the firing position. The bores of the pieces at

the end were practically as clean and bright as if they had not been used. I have not seen Colonel Lockett's report on this action, but he expressed himself to me as very much pleased with the action of the guns, so much so that he was anxious to have a gun and detachment permanently attached to his regiment for field duty.

On my return to Manila, I was notified to prepare to take three guns out in a few days with General Schwan's Expeditionary Brigade. Details of men were to be given me from Battery E, 6th Artillery, and mules for packing, as the country to be passed over would probably not be practicable for hauling. I requested that the men might be excused from other duty and placed under my control, so that I might have a chance to fit the pack saddles, prepare ammunition and have some preliminary instruction. However, the regimental commander did not approve of this, but required the men to perform all duties, drills, guards etc., with the battery up to the morning of departure, so that there was very little chance for proper preparation, especially as the mules were not shod and turned over to me until seven o'clock in the morning of the day I moved out. However, as soon as the men were carefully selected, they soon learned the duties from practical experience. I was required to carry sixty rounds per gun, and was provided with twenty-seven pack mules, twelve for the gun and fifteen for ammunition. This allowed me no extra mules to replace any disabled in action or by accident. I requested to be furnished some extra pack mules to carry rations and to replace any disabled, but instead was given a four mule team which was able to keep with me only four days, after which rations were carried on the persons of the men and on the gun and ammunition mules. My detachment consisted of six non-commissioned officers and thirty privates, also three civilian packers.

I left Manila at 8.30 a. m. Jan. 3d, 1900, and marched to San Pedro Macati, the starting point of the expedition. Remained there till the next afternoon, which time was devoted to drilling and instructing the men. At 2 p. m. Jan. 4th, left San Pedro Macati and encamped that night on a hill above Laguna de Bay, near the entrance to the Pasig River. The next morning, left this camp and marched to Muntinlupa on the Laguna. Took one gun with the advance guard on this march, as resistance was anticipated, but no enemy was encountered. The next morning, left Muntinlupa with the cavalry column and engaged in a sharp skirmish near the town. The enemy was driven back and pur-

sued to Binan, from which place he was dislodged by an infantry column which had proceeded to the town by a shorter road, the cavalry and artillery being delayed by two almost impassable fords, such that the guns and ammunition had to be carried over by hand and repacked on the other side. On the 7th the command left Binan for the interior of Cavite Province. I accompanied the advance guard again with one gun, while the other two were in rear with the main column. The command encamped that night at Silan, while my detachment encamped about half a mile from the town, there being a very difficult crossing on the trail which was not reached by the rear guns until dark, so that I preferred to wait and cross by daylight. The trail leading through the ravine in question was so steep and slippery that the Cavalry command lost two horses and a mule in making the crossing, and it was necessary for me to carry all my packs through by hand. Remained at Silan on the 8th, and on the 9th proceeded to Indan with two guns, one being left in Silan with the garrisoning battalion. While in Silan I obtained some axes and shovels from the engineer detachment, which I carried on my mules from this time, and which greatly assisted my progress by enabling me to make repairs to bridges and trails. My wagon had not reached Silan up to the time I left and I did not see it again until we returned to Manila. There were several difficult crossings between Silan and Indan, but a little pioneer work on the bridges and trails enabled me to keep up with the main column and reach camp at the same time. I was ordered to leave a gun at Indan, and to proceed with the remaining one on the 10th, with Colonel Gardener and a battalion of the 30th Vol. Infantry, in a southerly direction towards Lake Taal. Up to this time I had hauled the guns wherever practicable, but from reports received as to the nature of the trail ahead, I concluded that it would be a gain in time and a saving to both men and animals to depend entirely upon packing. During the remainder of this campaign this especial gun which always accompanied me was carried entirely by packing, and, in fact, could not, in most places, have been carried in any other manner.

The command reached Alfonso on the 10th, and remained there until afternoon of the 11th, when orders were received to proceed to Bayayungan on Lake Taal. As no trail to this place was indicated on the maps, word was sent to Colonel Gardener that he could send the artillery back to Indan if he deemed advisable. A native said there was a trail practicable for ponies, so I requested to be allowed to attempt the trip, as, if necessary, I could turn

back in case the trail was found to be actually impracticable. We reached the mountain above Lake Taal without any trouble about five o'clock in the evening and I started down with my detachment about six, reaching the town at the bottom about eleven. In many places the trail had been worn down to almost a point in the soft rock by pony travel, so that it was difficult to even lead a large horse or mule through, and utterly impossible to do so with the pack or saddle on. In these places it was necessary to completely unpack the animals and lead them through, and then carry the packs and saddles through and repack on the other side. This was rather difficult at night but fortunately there was a full moon, and the descent was accomplished in safety. The trail in many places was poorly defined, so that some of the infantry column strayed away and did not turn up in camp until the next day. Some idea of the nature of the trail can be formed from the fact that the following day, a cavalry pack train coming down with rations for our command, lost five mules in making the descent by daylight. The men in my detachment worked exceedingly well, and followed implicity the instructions given them. The command remained at Bayayungen on the 12th, in order to obtain rations. On the 13th we started along the north shore of Lake Taal and marched to Talisay, where we rejoined General Schwan and the main column. During this march, it was necessary to lead the aminals through the lake for about three hundred yards, the water being about breast deep, there being no practical trail on the shore. From Talisay, the command proceeded the same day to Santo Tomas, making a march of over twenty miles for that day. At Santo Tomas I was placed in command of the artillery of the brigade, ten guns, with Lieutenants Summerall and Buckey as Lieutenants. The guns were one 3.2" field gun, five Maxim-Nordenfelt mountain guns, three 1.65" Hotchkiss mountain guns, and one Gatling gun. Lieutenant Buckey joined me at Talisay and Lieutenant Summerall at Lipa the next day. We left Santa Tomas about four o'clock on the afternoon of the 14th and marched that evening to Lipa, about twelve miles. The next day two columns were started out for Batangas over different roads. I sent Lieutenant Buckey with one and Lieutenant Summerall with the headquarters column, accompanying the latter myself. We camped at Ibaan that night, and proceeded the next morning to Batangas, which was entered with slight resistance. From Batangas two of the Hotchkiss guns were sent back to Manila by steamer, being no longer needed. Lieutenant

Summerall was sent to Rosarie with a column on the 17th. On the 19th, at 4 p. m. Lieutenant Buckey and myself were sent with a battalion of the 30th Volunteer Infantry, under Colonel Gardener. We marched to Rosarie that night over a very rough road, reaching camp about 1.30 a. m. Started on at 6.30 a. m., the 20th, and reached San Pablo at 7 p. m. making the total distance marched in 27 hours, about 36 miles. Men and animals were tired but otherwise in good condition. On the morning of the 21st I was sent with two Engineer officers and a company of Infantry to reconnoitre some reported trenches about four miles from San Pablo, and report upon the practicability of turning them. We found the trenches as reported and upon going along the road further, developed some concealed trenches beside the road from which fire was opened upon our party of four officers and two privates at a range of about fifty yards. Two of the enlisted men were wounded, but the rest of the party were uninjured. We returned and reported to General Schwan, and he sent a battalion of infantry to endeavor to turn the position, directing me to accompany this command with one gun. Lieutenant Summerall was sent with the advance guard of the main column with one 3.2" and one Maxim-Nordenfelt, while Lieutenant Buckey with the remainder of the guns accompanied the main column. After pushing my way for several miles through a dense undergrowth and over very rough ground, an order was sent me by Major Cheatam commanding the column to turn back to the road, as the head of the column had reached a wall of rock down which animals could not be taken. This order was brought me by Captain Crozier of the Ordnance, who had accompanied the column up to this point and who now returned with me, as he could lead his horse no further. In the meantime the main column had engaged the enemy and driven them from the position. Lieutenants Summerall and Buckey were both engaged. At the first shot from the 3.2" gun the elevating screw was broken and the piece rendered unserviceable, so that all the work was done by the Maxim-Nordenfelts, and it was reported to be very satisfactory. My detachment overtook the main column just after it went into camp at San Mateo, but the infantry turning column did not get through until late in the evening. The next morning Lieutenant Buckey was sent with a column to Santa Cruz, while the main column proceeded through Lilie against Majayjay, which was reported to be strongly defended by the enemy. The 3.2" gun and the Hotchkiss were sent with the wagons to Santa Cruz, as the trail was said to be

too rough for their use. and the two Nordenfelts taken with the column. On approaching the position, which was found to be strongly defended by trenches, a ridge was occupied by our forces about six hundred yards from these trenches, and the guns placed near the extremities of the line where they would have the best command of the enemy's defences. Everything was prepared for action and small gun pits dug to shelter the men and ammunition to some extent. It was not deemed advisable to attack the enemy that day, so I was ordered not to open fire, and the following morning they retreated on account of a column of our forces having entered the town in their rear. On crossing the river to the position, it was found that our guns had a perfect command in reverse of their main works, so that our fire would have rendered them untenable. On reaching the town, I was ordered to take two Maxim-Nordenfelts and endeavor to overtake Colonel Gardener, who had been sent in pursuit of the retreating enemy. As he had an hour's start and the trail was extremely rough, I did not overtake him until nine that evening at the town of Luisana. One of the guns had been hauled as far as Majayjay, but on leaving that place, I found that nothing on wheels could travel over the trails. This detachment was short one mule, sent back on a foraging expedition, but by using my saddle horse as an ammunition animal, I managed to pack the gun all right and brought the entire outfit through in good order. The next day we marched from Luisana to Pagsanjan, skirmishing occasionally with small parties of the enemy on the way. To enter Pagsanjan it was necessary to cross a deep river on a ferry made of small native boats. It was impossible to get the mules on this ferry so the packs and saddles were put on the boat, and the mules made to swim the river. The next morning, January 25th, Santa Cruz on Laguna de Bay, the end of the expedition was reached. From this point one gun under a sergeant of the 5th Artillery, was sent with the 30th Volunteer Infantry to occupy Tayabas Province, and Lieutenant Buckey, with another, accompanied an expedition to the East coast of the Island, while Lieutenant Summerall returned by boat to Calamba, his regular station. I remained at Santa Cruz until February 9th, when I was ordered to return to Manila by boat and report to Department Headquarters, the Expeditionary Brigade having been dissolved. Before leaving Santa Cruz, General Schwan sent for me and told me that there would probably be no more field duty for me, as the actual fighting was over; and as my battery and regiment were in the United States,

he thought that I was entitled to return there if I so desired. I told him that I would not care to return if there would be any chance for further field duty, and he said he did not think there would be. After returning to Manila and remaining in the city for nearly two weeks with no work to do, and no prospect of any, I wrote a letter requesting that if my services were no longer needed for the duty for which I had been sent out, that I might be returned to duty with my battery. On February 23rd the order for my return was issued, and I sailed from Manila on the sixth of March on the U. S. A. T. *Sheridan*.

### CONCLUSIONS.

During my stay in Luzon I am convinced that I gave the Maxim-Nordenfelt 75 mm. mountain gun and pack outfit as severe a test as could be possibly given it in practical use. In many respects the circumstances were exceptional. The country traversed was probably as rugged as can be found in any part of the world. Cavalry officers who had been through Northern Luzon informed me that the Southern part was much more difficult to penetrate. The men furnished me were utterly ignorant of the gun and method of packing, none of them having had any previous experience with pack animals. The mules were many of them unaccustomed to packs and not acclimated to the country, having been off the ship only a short time. Consequently if the results obtained were satisfactory, it would seem that the gun would easily fulfill all ordinary service conditions.

### ACTION OF GUN AND AMMUNITION.

The behavior of the gun and ammunition in actual use was excellent in every particular. The mechanism for taking the gun and carriage apart is simple, easily understood and so strongly made as not to be easily disabled. The guns taken out by me were hauled over rocks, and through rivers so deep that the guns were entirely under water. Often they were upset and dragged for some distance in that position. On one occasion the mule carrying the gun jumped from a bridge at least twenty feet above a stream, striking on his back, that is on the gun, on a rock, without inflicting the slightest injury on either gun or mule. At no time was any part of the mechanism in such condition as to interfere in the slightest degree with the perfect working and dismounting of the gun. It was thought by some that the elevating mechanism was so low on the carriage that, when hauled through mud, it would become clogged with dirt and unserviceable. This was thoroughly tested. The gearing

mechanism is so simple that it practically cleaned itself, and even if not, the dirt could be easily brushed out with the fingers or a cloth. And, of course, when packed, which should be the normal method of transportation, there could be no danger from this source. The recoil was almost eliminated by the recoil cylinders and trail spade, and it was not found necessary to use the brake ropes on the wheels. Owing to the heat of the climate and the newness of the guns, there was a very slight leakage from the cylinders but it was easy to supply this deficiency with cocoanut oil found at camping places, and water could be used if nothing else was available. I consider that the advantage gained by controlling the recoil much more than compensates for the extra mule required to pack the cradle.

### HAULING ARRANGEMENTS.

For hauling, the shafts furnished were unsatisfactory, being altogether too fragile. It is presumed that the intention is to haul the gun for short distances only over smooth roads, but the shafts are not strong enough for even that. Every pair used by me broke in a short time, most of them in several places, so that they were abandoned as unserviceable, and where hauling was continued, improvised arrangements were made with ropes, shafts from native wagons or from the 1.65" Hotchkiss gun. The castings of the shafts were very thin, cast about a wood centre, and full of flaws. Strength seems to have been sacrificed to lightness, although a few more pounds in weight would not make any appreciable difference in the packing arrangements. An improvement might be made in the method of attaching the shafts to the saddle, the present method causing too much strain on the breast strap and consequent chafing.

### AMMUNITION.

The ammunition used was perfectly satisfactory. Shrapnel and shell were the only kinds used, and they are the only kinds really necessary for the conditions existing in the Islands. Very few occasions will arise necessitating the use of case and even then shrapnel will fulfill all the requirements, while for ordinary field use, shrapnel is the ammunition needed. For each 12 rounds taken, I considered 10 shrapnel and 2 shell as the proper proportion. There were no misfires, and every round burst, either on impact or as set for time, There were no premature explosions or failures. Although subjected to severe usage in packing, the ammunition was always in shape for use, and the

metal packing cases were so excellently arranged that the shrapnel could always be carried fused ready for immediate use without danger.

PACKING EQUIPMENT.

With some few minor exceptions the pack saddle is the best I have ever seen. The fair leather straps are rather light for hard work, and many of them broke. This was partially due to the buckles, and it would be a great improvement to substitute a lashing for the buckle. Of course the latter is more convenient with uninstructed men, but the lashing can be easily learned, and then there would be no danger from broken buckles or straps cut out by the tongue of the buckle. The girth straps were all too short for our large mules, and it was necessary to double most of them. While inspecting the saddles at Erith I called attention to the length of these straps, and a number of extra straps were put in the boxes, although the people at the factory were sure the saddle straps were long enough. The cinches are of cord and I do not think can compare with our hair cinch. The main cinch should be broader. It might be an improvement to have a special saddle for the trail, so that it could be raised in rear. Otherwise the spade part is apt to hit the animal on the tail as he walks. It was necessary to prop up the rear of the trail by placing a blanket roll or some other support between the rear brace of the saddle and the trail, and to put on two or three extra lashings to secure it properly in place. This was the only load which caused any difficulty in packing. The others were very evenly balanced, and after being once properly secured in place caused very little trouble on the march. The gun load, the heaviest, seldom shifted position, and the cradle wheel and ammunition packs would be carried all day without requiring any attention whatever. Two strong, even gaited mules were selected for the gun and trail packs, and after a couple of days experience for men and animals, the loads shaped themselves so that they would not require attention for hours, although the animals were climbing the steepest hills, jumping ditches, etc. The construction and fit of the saddle is far superior to any I have seen, so far as regards ease and comfort to the animal. On the trip through Southern Luzon I started out with men who had no experience with packing of any kind, with saddles unfitted and with mules unaccustomed to packing. At times the saddles were wet and placed on the mules in that condition. On one occasion two mules jumped from a bridge into a stream, so that it was necessary to unpack them in

the water, leaving the packs and saddles in the stream. These were then fished out and placed on the mules in this condition and the march continued for several hours. The mules were foraged on unhulled rice when it could be obtained, but often had to be satisfied with banana and palm leaves. The gun detachment which remained constantly with me travelled fully 260 miles under these conditions, making one march of nearly 38 miles in 27 hours. Yet up to the end of the expedition not one of my mules became disabled or exhausted, nor did I have a single sore back or saddle gall, the mules reaching Santa Cruz in fully as good condition as when they left Manila. During this time we were constantly with cavalry pack trains fitted out with aparejos, and the contrast in the condition of the mules was most striking and was frequently commented upon. The fact that the saddles are interchangeable is a great advantage, especially where packing is to be hurried and before daylight, as was frequently the case in my experience, a few candles furnishing the only light.

### COMPARISON OF MAXIM-NORDENFELT WITH OTHER GUNS USED.

From my own experience, and from conversation with other artillery officers, it is my opinion that a mountain gun of this or similar type is the gun needed for service in the Philippine Islands, and probably the only kind needed. The greater portion of the Islands is absolutely devoid of any practicable roads. In places where the Spanish Government had constructed fairly good roads, through neglect and the ravages of the climate these have become even more difficult than the ordinary trails. This state of affairs is greatly increased during the rainy season, when for months a large portion of the country is practically impassable for anything on wheels. The 3.2" field gun, although fairly good in its place, must be hauled, and consequently is only useful in a country provided, to some extent at least, with roads. When accompanying a column, bridges must be repaired, banks to fords cut down, etc., all of which tend to delay the advance. Infantry officers anxious to push ahead are not apt to make allowances for these difficulties to be overcome by the artillery, and although fully appreciating its usefulness in actual combat, would make complaint if they were called upon to delay in the least to assist the artillery ahead. This happened frequently, although the artillery officers were doing everything in their power to overcome the obstacles and hasten the advance. Furthermore the gun and carriage did not seem to

stand the rough usage it was called upon to undergo over well, and there was constant necessity for repair to elevating screws, vent bushings, etc. There was also great complaint as to the ammunition, especially regarding the shrapnel, there being many premature explosions, sometimes in the gun itself, so that it was not always considered safe to fire over the heads of the advancing troops. This was probably due to some accident in manufacture, and should be easily remedied. But I believe any system for field artillery of this class is radically defective which does not involve the quick firing principle and the use of fixed ammunition, this being necessary both for the proper protection of the ammunition, and quick and accurate service of the piece. The 3" Hotchkiss mountain gun was used to a considerable extent, and did some good work, but the packing arrangements for this gun are not satisfactory, and it was hauled whenever in use. I have never seen the gun packed, but am informed that the saddles are so poorly constructed that the back of the mule is galled in a very short time. Another objection to the gun is the excessive recoil, which, I am told, was often as much as fifteen feet, the gun being overturned. This would be a great obstacle to any rapid fire. The 1.65" Hotchkiss mountain gun I consider as practically useless for field work. It is too light and fires only a shell with a small bursting charge, while shrapnel is the ammunition needed. It is of practically no use against trenches, or lines of troops.

The 75 mm. Maxim-Nordenfelt gun seems to me to more nearly fill the requirements for a gun to be used in our Island service than any other gun of which I have knowledge. It is essentially a modern gun with all the modern improvements. The comparatively low initial velocity, gives enough of the curve to the trajectory to render it more effective against trenches than the high power gun with a flat trajectory. Of course it has not the penetrating power of the latter, but still has sufficient to overcome any obstacles that are likely to be opposed to it. In the fighting for which it will be used, there will be no strong fortifications or walls to be beaten down, only trenches and light shelters, for which small penetrating effect will be needed and shrapnel practically the only ammunition. The gun is sighted up to 4000 yards, and was fired by me with good results at 3200 yards. No greater range than 4000 yards will ever be required, and most of the fighting will be under 2000 yards at which short ranges the gun is very accurate and effective. The shrapnel and shell used is quite heavy enough, 12.5 pounds, although a

heavier one can be provided, if required, and a sight scale is furnished for the heavier ammunition. The ammunition used by me was made in England, the fuzes being of the Krupp pattern, and the action was perfect. I know of no reason why equally good ammunition should not be made in this country. The almost complete control of the recoil by the cylinders attached to the jacket is an advantage that can not be over estimated, if the gun is to be used under circumstances calling for rapid fire. The action of the cylinders is simple and they can be filled with water if no other fluid is available. The leakage was very slight, even under unfavorable conditions. The breech mechanism is very simple, opening by a single motion, and can be entirely taken apart without the use of any tools. The coning of the breech block is such that the largest surface is next to the powder chamber where the greatest resistance is needed, so that there is no danger of the threads stripping. In fact, all parts of the gun and carriage are so constructed as to combine strength and simplicity in the greatest possible degree.

On account of the jacket one more mule is required for the packing than with the Hotchkiss. But the loads are so well distributed that there is very little danger of a mule giving out and there is not so much need for spare mules as with the other gun. The ammunition boxes are well balanced on the mule, and the ammunition is so well protected that there is no danger from accidental explosions, even though the mule should jump from a bridge or roll down a bank. One artillery officer stated to me that he considered the time taken to lead the mules into position and to unpack and put together the gun as a great drawback; that the 3.2" gun could be brought up at a gallop by six horses and unlimbered in a very much shorter time. This might be true if all conditions were favorable for the larger gun. But in a country with no roads, with ditches to cross and bushes to penetrate, it would seem to me that the advantage would be in favor of the led animals. When my unskilled detachment could unpack the gun and place it in the firing position within two minutes, I do not consider that this matter of time would be worthy of consideration, especially when balanced against the many places in which the mountain gun could be taken and used, where the larger gun would be absolutely unserviceable. Officers with whom my detachments have served stated that they were thoroughly convinced that the gun could be taken wherever an infantryman could go without using his hands for climbing. If all the light batteries should be withdrawn from the field and

replaced by a lesser number of batteries of these mountain guns, I am convinced that the artillery work could be much more effectively and creditably performed, and there would be no opportunity given for any complaint as to delay being caused by the artillery. My detachments were always ready in the morning before the infantry, and were often held back on the road by the foot troops.

ORGANIZATION OF BATTERY.

As to the organization of a mountain battery, I was given no opportunity to test that practically, as I was sent into the field with three guns at the most, and before going was directed to designate the least number of men and animals with which I could possibly get along, and this number was given me at the moment of departure. I had no spare animals, and had one been disabled, would have been compelled to abandon a portion of my outfit. By good luck, no such misfortune happened to me. On my way out of Manila, I obtained what works I could on Mountain Artillery, and formulated a plan for the equipment of a battery of six guns, which was submitted to the Department Commander on my arrival in Manila. In this plan, I estimated that each battery should have one captain, three lieutenants, total commissioned 4; one first sergeant, one quartermaster sergeant, one stable sergeant, one blacksmith, one saddler, two cooks. two trumpeters, six sergeants, six corporals, and ninety cannoneers,—total enlisted, 111.

ANIMALS.

| | | |
|---|---|---|
| For mounting officers, staff sergeants and trumpeters | 9 | horses. |
| For mounting cooks, blacksmiths and saddler . . . . . | 4 | mules. |
| Gun Mules. . . . . . . . . . . . . . . . . . . . . . | 24 | mules. |
| Ammunition. . . . . . . . . . . . . . . . . . . . . | 30 | mules. |
| Blacksmith and saddler outfit . . . . . . . . . . . . | 3 | mules. |
| Spare animals . . . . . . . . . . . . . . . . . . . . | 15 | mules. |
| Total animals . . . . . . . | 85 | |

In addition to this each battery should have a small pack train of about 15 mules to carry rations, etc., if the battery is to move as an independent organization, making a total of 100 animals. This is a much smaller number than that given for the English mountain batteries, especially in India, but it would seem to be ample for all the ordinary requirements of service. The pack train could be cared for on the march by the quartermaster and stable sergeants, cooks, blacksmith and saddler.

The service of the piece and drill for these guns would be very simple, and any technical method would probably be subject to more or less modification to fulfil the requirements of actual service.

Very respectfully,

George W. Van Deusen,
Captain, 7th U. S. Artillery.

# THE SECOND BOER WAR.*

## II.

### THE CAMPAIGN IN NATAL CONTINUED.

After the battles of Dundee, Glencoe and Elandslaagte, the respective forces in Natal were probably about as follows:

*British.* Infantry 7,800, cavalry 1,050, artillery 45 guns, volunteers (Natal volunteers and Imperial Light Horse) 1,000.

*Boers.* 17,000 men, 40 guns (including six 40-pounders).

The Boers, under Meyer, (2000), who pursued Yule's column, came into position at Modder Spruit and Vaalplaats; the Orange Boers (7000) arrived at Matawans Hoek; while Joubert's main body closed in from the north.

The question naturally arises why did not White retire toward Pietermaritzburg as soon as he found himself unable to longer hold his advanced position without danger of being cut off. The reasons probably are that he had orders to hold out (for political reasons and moral effect) as long as possible; moreover, the worn-out troops of Yule undoubtedly needed rest.

In case retreat had been attempted, there were three roads open to White. *First,* the road running east from Ladysmith and then branching to Weenen, or going on to Pomeroy and thence to Greytown; *secondly,* over the open ground between the Isimbulwana hill and the Klip river; *thirdly,* the road south, over Nelthorp and Colenso. But the Boer guns on Lombardskop and Isimbulwana hill commanded the first and second, and the left bank of the Modder Spruit was occupied in force by two Boer commandoes (Meyer and Erasmus). It appears, however, that White had decided to hold Ladysmith.

#### The Battles of Farquahar's Farm and Nikolson's Nek.

On October 30 White decided to attack the Boer forces, but the difficulties were very great, for he had to start under artillery fire from the Isimbulwana hill, and the Boer columns were now united.

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* In addition to the authorities cited in the first part, the author desires to express his obligations to the following: *Boer War*, Lieut.-Col. H. M. E. Brunker, *New York Sun*, *Kriegstechnische Zeitschrift*, *The Engineer* (London), *Engineering* (London), *Der Buernkrieg in Südafrica*, *v. Estorff*.

Colonel Carleton with the Irish Fusiliers, the Glocestershire battalion and a mountain battery, constituting his left wing, was sent to Nikolsonseck to hold in check the Boers on Lombardskop, and to cover the left and rear. The center was composed of 3 batteries, 2 cavalry regiments and 4 infantry battalions, and advanced towards the Isimbulwana hill to prevent the Boer troops there from moving against the right column. The latter, composed of 4 batteries, 3 cavalry regiments and 5 battalions, moved on the Nelthorp road. A naval brigade with two heavy guns, just arrived, also took part in the engagement.

The Boer outposts retired before the British center, and the latter in advancing lost touch with the right. This right soon found itself outflanked, was compelled to change front under fire and had to call back the center to assist it. Nevertheless, the right thus reinforced was driven back completely routed, covered by the 23d battery. This is known as the Battle of *Farquahar's Farm.*

Meanwhile, the left column moved on unmolested to Nikolsoneck, except that as they arrived there two large boulders were rolled down from the heights by a Boer patrol, and at the same time there was a blast of artillery fire, and this so frightened the mules that they ran, and the entire mountain battery with all the wagons of reserve ammunition were lost. The infantry held the position, however, and intrenched. But the Boers having been reinforced, and the right and center having fallen back, this entire column was finally captured. This is called the battle of *Nikolson's Nek.*

The British lost in these two engagements several hundred killed and wounded, 5 guns, the entire train, the ammunition column, and 1,500 mules.

The losses in detail were: 6 officers, 57 men killed; 10 officers, 221 men wounded; 38 officers, 977 men missing.

It is probable that White, in first making this attack, had decided, if successful, to retire further south, but his failure determined him to hold on to Ladysmith rather that abandon the great supply of stores there.

On the evening of the 30th there were 5 commandos of Boers south of the city, between the Klip and the Flagstone, with a second line in rear occupying Nelthorpe and Pieter stations; another commando intrenched on the Lombard kop; 2 commandoes (Meyer and Erasmus), 2,000 strong, east of the Bulwantkopje; while on the north and north-east Joubert had seven camps in a semi-circle from Lombardskop to the road from Van

Reenens Pass; and finally 2 Orange commandos coming from Dewdrop-spruit, joining hands with Joubert west of the town.

On November 3 White once more attempted to push back the Boer lines between the Klip River and the Isimbulwana Hill. The point, 3,000 men, under General Murray, including a greater part of the cavalry and several batteries, managed to push through the Boer lines and escaped to Estcourt, the rest were forced back to Ladysmith.

General Joubert, after leaving the proper force to continue the siege of Ladysmith (the garrison of which was now reduced to 7,000), continued his stragic march in three columns, one to strengthen the corps at Colenso and advance west of the railroad, the second advancing over Weenen, the third over Greytown. The corps which had penetrated into Zululand crossed the lower Tugela, and threatened the communication between Pietermaritzburg and Durban, from the vicinity of Stanger.

The further advance was thus to be a grand right wheel of the Boer army, to be followed by a concentric advance on Pietermaritzburg. But the arrival of the 2d Brigade, 1st Division, of British reinforcements under General Hilyard at Estcourt caused a temporary change. General Botha's Boer corps (7,000) from Colenso came to a stand, the corps originally at Colenso moving over Ulundi-Courton west of the railroad took the British in the left flank, that moving over Weenen took them on the right flank, while that sent over Greytown was to take position at Pietermaritzburg.

General Buller, who arrived at Cape Town on October 31st, remained there till November 16, when he started north, and on the 26th was at Pietermaritzburg. Meanwhile 17 transports (with about 19,000 men) arrived at Cape Town, 10 being sent on to Durban, where the troops were landed to operate towards Ladysmith, the troops from the others being sent north by rail to Orange River station, Gen. Methuen in command.

The besieged cities of Ladysmith and Kimberley evidently determined the British plan. Part of the reinforcements were sent to Sir Buller in Natal, another part from Cape Colony to Orange River Station under Lord Methuen, a third and fourth under Generals Gatacre and French, respectively, to threaten the Orange Free State. The reinforcements were too small to warrant such a subdivision into four widely separated columns. It would have been better to have concentrated the entire force in Natal against the main Boer army, or to have retained the Boer

army there and invaded the Orange Free State with a strong column in the center or left.

In the composition of the units there are decided elements of weakness, for the force under Clery in Natal has parts of three different divisions, the others being in one or other of the other columns.

General Clery assumed command of the forces south of Ladysmith on the 18th. A Boer column reached Nottingham road and moved over Ulundi to Highland station (Mooi River) on the 21st, cutting off Estcourt. The British forces, 2,000 each, one under Hildyard at Estcourt, the other under Barton at Weston, were thus surrounded. The Boers had a splendid opportunity for a tactical offensive which should have led to decisive results, but General Joubert decided to retire and concentrate his forces on White at Ladysmith. On the 21st General Hildyard attacked the Boers at *Willow Grange* and drove them back restoring communication with Weston. Hilyard's force consisted of 700 mounted men, the 7th and 66th field batteries, and three battalions (East Surrey, West Surrey and West York). He lost 13 killed, 65 wounded, and 9 missing; the Boer loss is reported as 30 killed, 100 wounded. The troops from Estcourt and Weston then advanced to Frere, the Boers retiring to Colenso.

By the 22d of November 33 troopships had arrived at the Cape, carrying 34,516 officers and men.

EVENTS IN THE SOUTHERN AND WESTERN THEATRES.

On October 30th a Boer attack on Mafeking was repulsed with loss: British lost 2 officers and 4 men killed, and 5 men wounded.

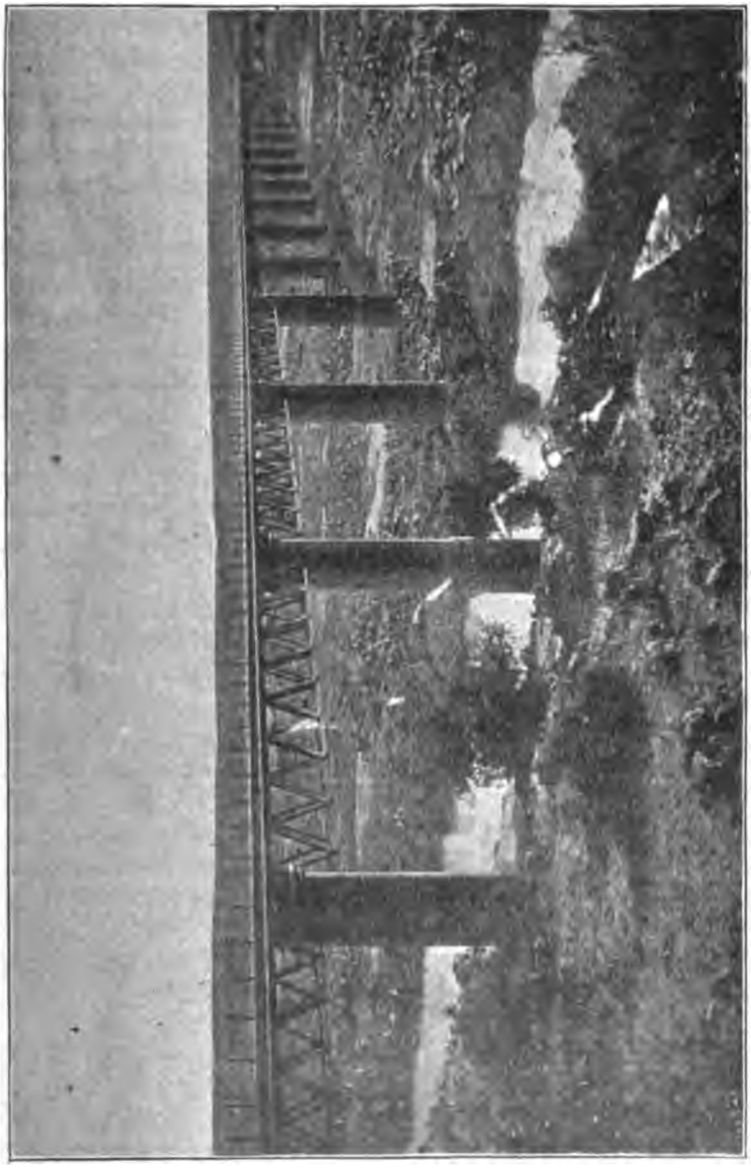
On November 1st a Boer force crossed the bridge at Norwal Fontein and occupied Colesburg, and another (3,000 under Commandant Dutoil) assembled at Bethulie bridge. On the 2nd a detachment (3,500) crossed the bridge at Bethulie, the British force at Stormberg junction retiring to Queenstown.

The Boers were operating at this time south of the Orange River in three columns: the right (2,000) against De Aar and the Cape railroad; the center (1,000) pushing out on the Colesburg road; and the left (3,000) against Queenstown and Port Elizabeth; a reserve of 4,000 at Bethulie.

At Mafeking there was daily skirmishing. Colonel Plumer from Tuli was on the way to relieve this town.

Lord Methuen arrived at Orange River Station on November 9th. General French, who had escaped from Ladysmith on the last train out, Nov. 2d, obtained command of the troops pushed out to Naauwpoort.

On the 10th of November a British reconnoitring party, under Colonel Gough, composed of 2 squadrons of the 9th Lancers, 1½ companies mounted infantry and a field battery struck a force of



700 Boers at a point about 3 miles west of Belmont and had a sharp skirmish with them.

On November 19th a Boer commando, 500 strong, attacked

Kuruman, but was repulsed. On the 20th Cronje left Mafeking for the south, the commandos of Snyman and Malan remaining to continue the siege.

Meanwhile, Lord Methuen developed his plan of operations in the west. After repairing the bridge at Orange River Station, he advanced with 6,000 men on the 21st of November against Belmont. The country is flat, with only low ridges, 100 to 200 feet high, crossing it, and two miles south of Belmont rises the Kaffirs Kop, which is much higher. On the 21st he reached Witteputs and on the 22nd Devendale (about 5 miles south of Kaffirs Kop). The Boer forces were commanded by Cronje. On the 23d the attack began against the first rise, which was quickly taken, followed by the storming of the second rise, the cavalry acting on the left flank to turn the Boer right. The third rise was carried with more difficulty, but being most effectively supported by the artillery, the Boers retiring to the Kaffirs Kop. The cavalry was too much exhausted to pursue. This is known as the Battle of *Belmont.*

The British lost 4 officers and 20 men killed, 50 officers and 218 men wounded, and 2 missing. Among the wounded was General Fetherstonhaugh, commanding the 9th brigade, who was succeeded by General Pole-Carew.

On the following night (24th and 25th) Lord Methuen again advanced. He moved over Shalk Farm, in order to go around the Kaffirs Kop and Belmont, and was approaching the railway station Graspan, when the head of the column ran into 2,500 Boers concealed in a depression of the ground, near Enslin, while 500 Boers from the Kaffirs Kop attacked the rear guard. Lord Methuen engaged them in front with the naval brigade, and turned their flanks with the 9th brigade, while the cavalry threatened their rear. The Boers retired to the Modder River. The cavalry was too weak to pursue. This is the Battle of *Granpan* or *Enslin.*

The British force under Lord Methuen in this action comprised:

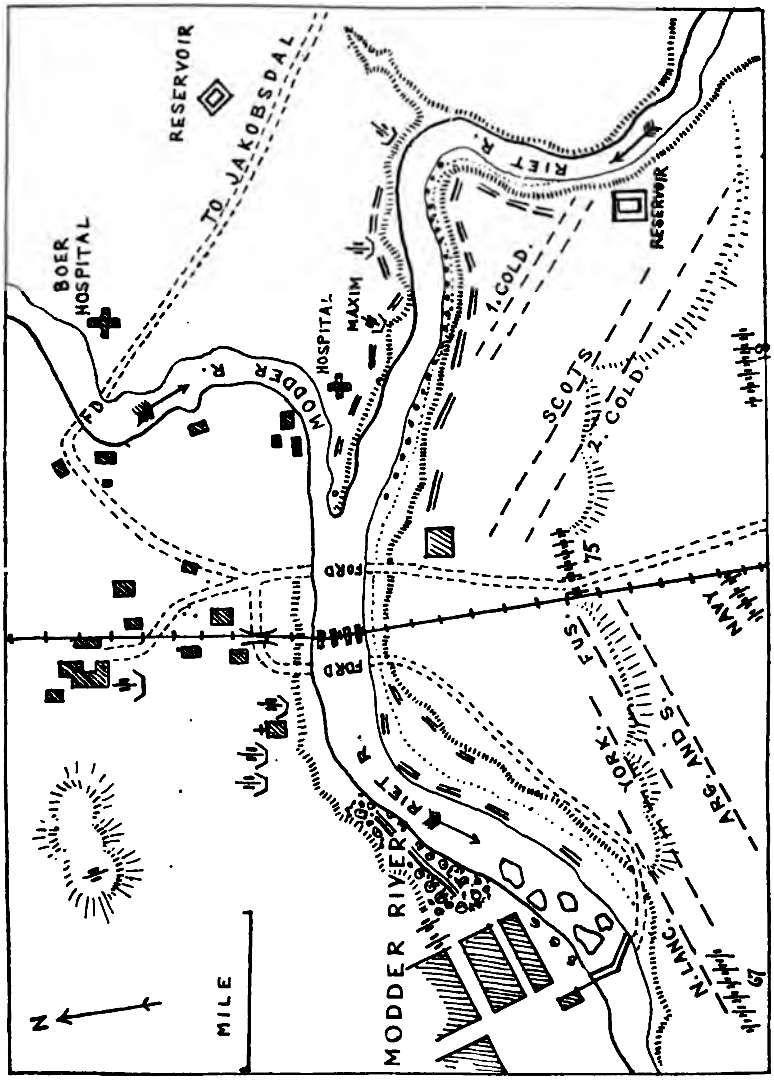
9th Lancers.
Billington's Scouts.
2 field batteries.
Guards Brigade (Colville).
9th Brigade (Featherstonehaugh).
Naval Brigade (Captain Prothero, from the *Doris*).

The Boers, under Cronje, were about 3,000 strong, with 6 field guns and 2 machine guns.

The British lost 4 officers and 20 men killed, 5 officers and 161 men wounded, 7 missing.

### The Battle of Modder River.

Lord Methuen, after resting for a day, and reconnoitring to the front, continued his advance in the night of the 26th. Nothing had been seen of the enemy. The column halted for the




night at Klokfontein Farm. At 4 A. M. Methuen resumed his march, the 2d battalion Northamptonshire regiment as advance guard, the 2d battalion Yorkshire Light Infantry leading the

main column. The total strength (including reinforcements joining on the battlefield) was about 8,500 men, with 22 guns (including 4 naval guns). The Boers numbered about 8,000, with 10 guns, and were under Delarey and Cronje, their artillery under Albrecht.

The village called Modder River (see sketch) lies on the north bank of the Riet, just west of the junction of the Modder. The Boer position was in shape a crescent, its center opposite the bridge, its right flank resting on a group of houses north of the dam, its left flank at a farm beyond the Free State border. The Riet, although swollen at this time, was fordable at several points, and both banks are covered with trees and thick brush. The railroad bridge had been destroyed by the Boers. The islands above the dam are covered with trees. The ground on the right bank rises gradually to the north and fully commands the south bank.

Although the principal Boer position was on the north side, their advanced line was on the south. Both were intrenched, the revetments covered with bags of sand and galvanized iron plates, and the approaches were obstructed with wire entanglements. Behind the advanced line the ground slopes down to the river, affording cover for horses and wagons, and communication over the river was effected by innumerable boats and rafts.

The artillery was all on the north side, 5 guns at the center, 2 on the right and 2 on the left flank; the Maxim gun near the junction of the rivers, and a Hotchkiss gun moved about as required.

Methuen, when at daybreak his patrols drew the enemy's fire, concluded it was merely an advance-guard fight that confronted him. After the cavalry and mounted infantry came in contact with the advanced line of the Boers, the artillery, under Colonel Hall, at about 5.30 A. M., took position at 4300 yards and bombarded the Boer left flank. The 9th Lancers and the mounted infantry protected the right flank of the artillery. The artillery duel lasted about two hours, then the infantry advanced in dispersed order, the naval brigade (1,000) and the artillery composing the center, the right formed of the Guard (3,500), under Colville, the left of the 9th brigade (4,000) under Pole-Carew. The latter was reinforced on the field by the 1st battalion of the Argyll and Sutherland Highlanders, coming from Orange River. The line advanced to within 600 yards of the enemy's position, but could make no farther progress and lay there all day. On the right repeated attempts were made to turn the Boer position. On the

left, however, a part of the 9th brigade succeeded in crossing at the dam, and in gaining a footing on the north bank. The artillery was active all day. At 3 P. M. the 62d battery arrived by rail. During the night the Boers evacuated their position. This is called the Battle of *Modder River.*

The British lost in this battle 4 officers and 68 men killed, 19 officers and 377 men wounded, 7 missing.

The total losses of these British columns of invasion up to and including November 28th were about 3,000 killed and wounded. General Methuen remained at the Modder River, repairing the bridge there.

After the disaster of Glencoe and the siege of Ladysmith, England proceeded to raise another (the 5th) division, and to organize a siege train. The later disasters decided England to raise still another (the 6th) division.

On the southern border of Orange Free State the British (under General French) reoccupied Naawpoort, November 19th, while the Boers from Aliwal North took possession of Jamestown, and moved on Dordrecht. Gatacre moved north from Queenstown and occupied Bushman's Hoek, November 27th, and the Boers destroyed the Steynsburg bridge, between Queenstown and Naauw Poort.

The general situation at the end of November may be summed up as follows:

In Natal the continuation of the siege of Ladysmith, and the holding in check of General Clery's relief force by the Boers on their strongly intrenched Tugela line. In the west the continuation of the siege of Mafeking and Kimberley, and the holding in check of the relief force under Lord Methuen on the Riet River. In the south the holding in check of Gatacre's division and French's brigade.

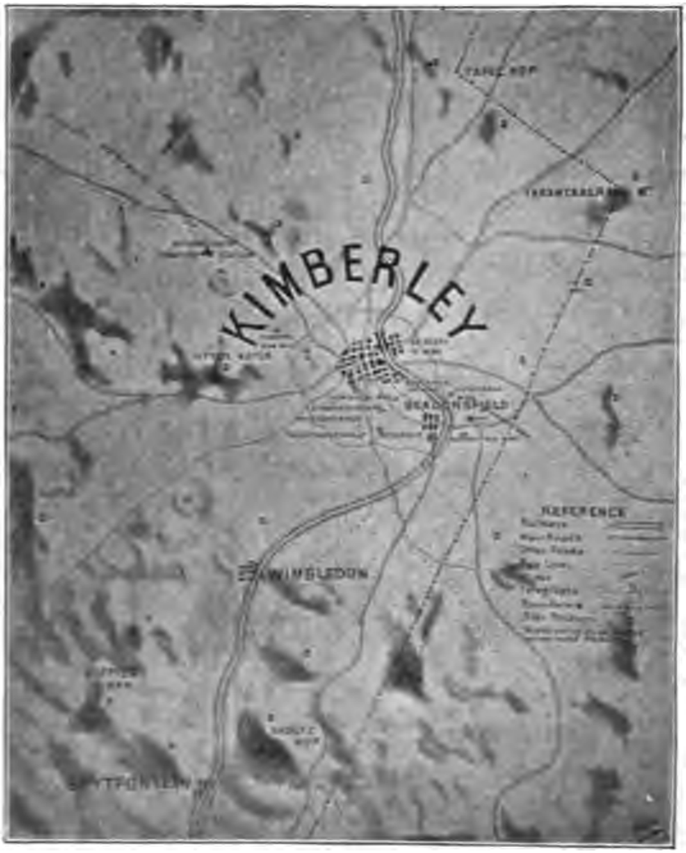
The strength of the Boer forces in Natal was about 25,000 men, south of the Orange River about 10,000, and in the west about 12,000, with about 1,000 on the northern border, and about 2,000 in the interior, giving a total of about 50,000. They had about 45 field guns and 20 Maxims.

General Buller (after the arrival of the first reinforcements) had command of about 34,000 infantry, 6,800 cavalry, 200 field guns and 40 Maxims (after deducting garrisons, etc.). By the middle of December the second reinforcements brought his force up to 40,000 infantry, 7,650 cavalry, 206 field guns; and by the

first of January (when the third reinforcements arrived) to 46,000 infantry, 7,650 cavalry, 229 field guns and howitzers, 50 Maxims.

### EVENTS SOUTH OF THE ORANGE RIVER.

General Gatacre's troops were concentrated at Queenstown to act in concert with French, in order to throw back the invading Boer columns.




On the 18th of November he had the following troops:

2d battalion Royal Irish Rifles.
2d battalion Bershire (part only).

These were reinforced later on by:

2d battalion Northumberland Fusiliers.
2d battalion Royal Scots Fusiliers.

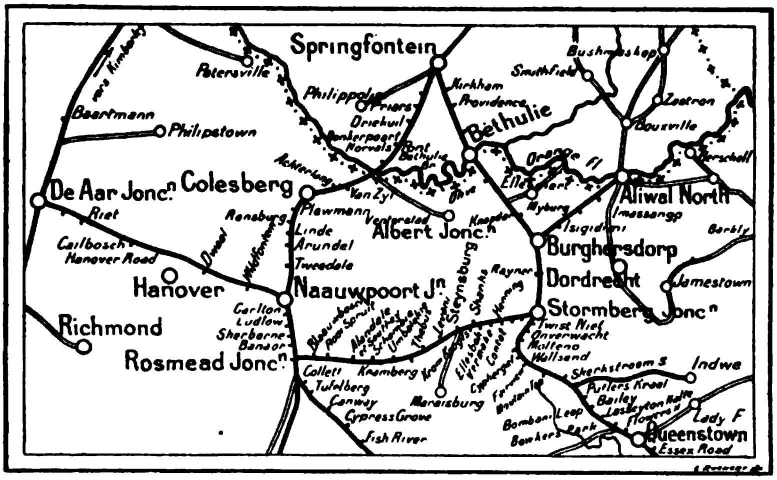
And on December 5th by:

74th and 75th field batteries, and
12th company, field engineers.

He also had some Cape Police, Kaffrarian Rifles and Brabant's Horse, all volunteers and irregulars.

His total force amounted to 3,500 men.

On November 22d he established his camp at Putter's Kraal, leaving about 1,000 men at Queenstown. He occupied Sterkstrom with about 300 men, and Bushmans-Hoek with about 800, but early in December he combined the two advanced posts at Molteno.




THEATRE OF OPERATIONS OF GENERALS FRENCH AND GATACRE.

On December 8th the Boers were distributed as follows: 800 men at Dordrecht, 700 (with 6 guns) on the way to Dordrecht from Jamestown, 1,500 at Stormberg, 400 at Molteno, and a small commando at Steynsburg. The Boers in the vicinity of Stormberg were commanded by Olivier.

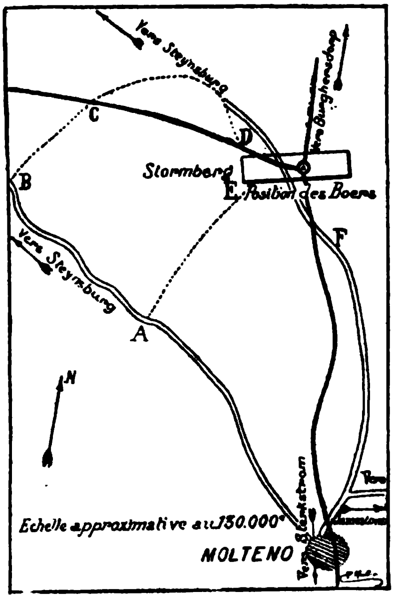
### The Battle of Stormberg.

At the beginning of December the Boers in the south were moving on Dordrecht, Molteno and Indwe. Meanwhile, Gatacre's troops remained inactive until the first week of December had passed. Then, to strengthen Lord Methuen's position, an offensive movement was decided upon. This was begun by a reconnoissance of General French in the direction of Arundel. His efforts to get an insight into the enemy's position failed, and on the 10th he was compelled to retire.

To further prepare for his advance, General Gatacre, on the 8th, sent Colonel Dalegetty with all his available cavalry and a half-battery against Dordrecht, with a view to taking this town

and threatening Stormberg (reported to be occupied by only 2,000 men) on the left flank.

General Gatacre himself, on the 9th, went by rail, with about 2,500 infantry, 200 cavalry and 2 batteries, to Molteno, and marched thence on the night of the 9th towards Stormberg (8½ miles), to surprise the Boer garrison. The column was to march along the Molteno-Steynsburg road for about five miles, then turn north-east directly towards Stormberg (at A, sketch), but in the darkness the troops moved on too far (B, sketch) and had to make a wide sweep (double the distance) to reach their objective, striking the latter on the north-west side, where it was practically unassailable. On arriving about 3 miles from Stormberg the head of column suddenly found itself under heavy fire in front and right flank. The Royal Dublins, composing the advance, broke and carried panic with them. A rally was effected behind a kopje, and a new position taken up to the rear, while the mounted infantry was sent against the right flank. Before the new position was occupied a Boer Maxim battery opened on the rear of the British, and they again retired in still greater disorder, and it was only behind the British artillery that order could be restored. Then a body of mounted Boers charged the retreating column, which Gatacre checked with two battalions, and continued his retreat to Molteno. The entire action lasted from 4 to 7 A. M. The Boers followed in pursuit and cut off the British rear guard of 612 men. The British lost 60 killed and wounded, about 700 prisoners and 3 guns. This is the Battle of *Stormberg*.




BATTLE OF STORMBERG.—*Cercle.*

The tactical mistakes in this advance are apparent. General French's movement could have for its object only one of two things,—it was either a feigned attack, with a view to drawing away from Stormberg some of the forces there, or else it was a

forced reconnoissance to get an insight into the situation at Arundel. In either case it was an error. In the first case it was absurd to hope to produce any effect on the garrison of Stormberg by a movement on a Boer force three day's march away. In the second case the object did not justify the use of such a large force: a few officers' patrols would have served the purpose.

Moreover, Gatacre's advance was not properly organized tactically, for there were no real flanking columns to insure against surprise, Colonel Dalegetty's raid not being such in a true tactical sense. Finally, the whole expedition was made by too great a force, over too great a distance, to give promise of surprise in a country friendly to the enemy.

This break in the center of the general British line endangered further advance by Methuen or Clery, and French was so weakened that he could hardly secure the railroad line to De Aar.

THE CAMPAIGN IN THE WEST.

On the western theatre of operations, at about the same time, important events were transpiring. Lord Methuen was forced to inactivity after the battles on the Modder and Riet rivers, not only because his troops were exhausted, but also because the Boers under General Cronje held the strong position of Spytfontein—Magersfontein in his front, and threatened his right flank from their position (under Prinsloo) at Jakobsdal, and even his line of communications from the rear, Orange Boers under Delaray, as early as December 2d, having turned up at Graspan, destroyed the railroad bridge there, and then worked round to the westward to cut off Lord Methuen. Efforts to dislodge these forces in rear proved unsuccessful, consequently Lord Methuen decided to proceed with his more immediate duty, the relief of Kimberley, and made his preparations to force the Boer lines in his front.

Immediately after the battle of the Modder River a bridge of boats was constructed over the Riet about 40 yards to the west of the railroad bridge, and an iron bridge was commenced to the east of the latter, which was completed by December 7, when the first train crossed.

Between the 3d and the 8th of December the following reinforcements reached Lord Methuen:

12th Lancers.
Horse Battery G.
Siege Howitzer Battery (4 pieces, 5-inch).
The Highlander Brigade (Gen. Wauchope).

A Balloon Section.
The 4.7 R.F. gun "Joe Chamberlain," from the *Doris*.
The Canadian and Australian contingents.

His entire command comprised 11½ battalions, 6 squadrons, 5 batteries, 1 battalion mounted infantry, 1 naval brigade, 1 naval battery of 5 guns, and about 1,100 volunteers, or, in all, about 13,000 men and 35 guns.

THE "JOE CHAMBERLAIN" ON THE WAY TO MODDER RIVER.—*Armée et Marine.*

The Boer position was in the form of a semicircle, composed of two ridges, Spytfontein in the western part, Magersfontein in the eastern, the railroad passing between them and dividing the

THE COLENSO BRIDGE AFTER ITS DESTRUCTION.

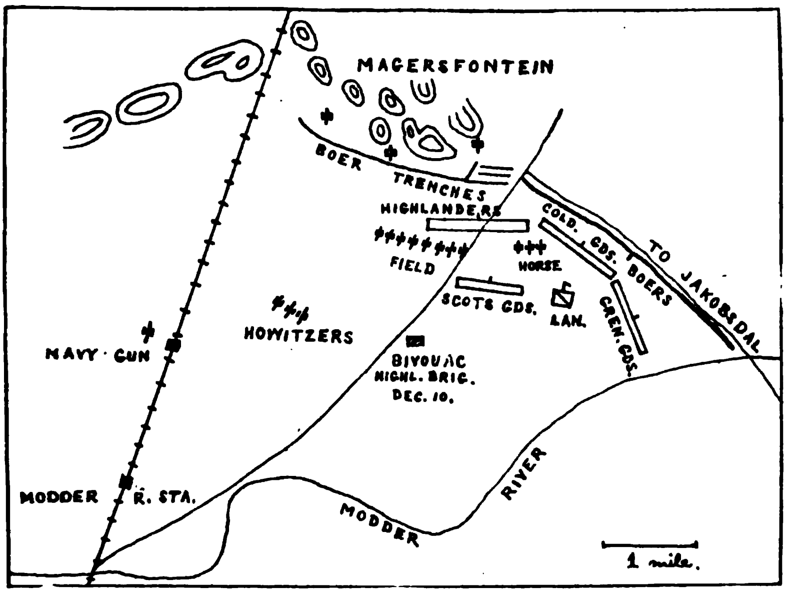
position into two nearly equal sections, that on the east side being much more strongly occupied than that on the west. The position was well intrenched, and at Magersfontein the trenches were so arranged as to allow of fire at different elevations at the same time. Cronje had about 6,000 men and 13 guns.

The Boers were reinforced by a number of commandos, one of which occupied Read's Drift, about 7 miles west of the Modder River, and another Jakobsdal to the east.

On the 10th of December, Lord Methuen, after leaving a flanking force to guard against a Boer advance from Jakobsdal, crossed the Modder River on the temporary bridge which he had constructed and advanced against the left (or stronger) flank of the Boer position.

### The Battle at Magersfontein.

On the morning of the 9th of December the 12 cm. naval gun moved out about a mile beyond the camp and fired some 15 shots at the Magersfontein heights, ten of them Lyddite shells; the




BATTLE OF MAGERSFONTEIN.—*R. du Cercle.*

cavalry had a light skirmish on the right, and the 9th brigade moved out in support. At 2 P. M. on the 10th Lord Methuen's command broke camp and began the advance, the artillery opening fire, from the position occupied on the preceding day by the

naval gun, on the heights at Magersfontein. For two hours the firing continued, but the Boers made no reply. The artillery, the Highland Brigade and the 9th Lancers bivouacked on the field during the early part of the night of the 10th, about 2 miles from Modder River Station, and the Guards moved up in sup-support. At 1 A. M., in a heavy rain, the advance was continued.

The station of Spytfontein is about 10 miles from Modder River. The ground rises gradually to about 5 miles north of the Riet, then it begins to be cut up by kopjes. These lines of kop-

A Kopje.

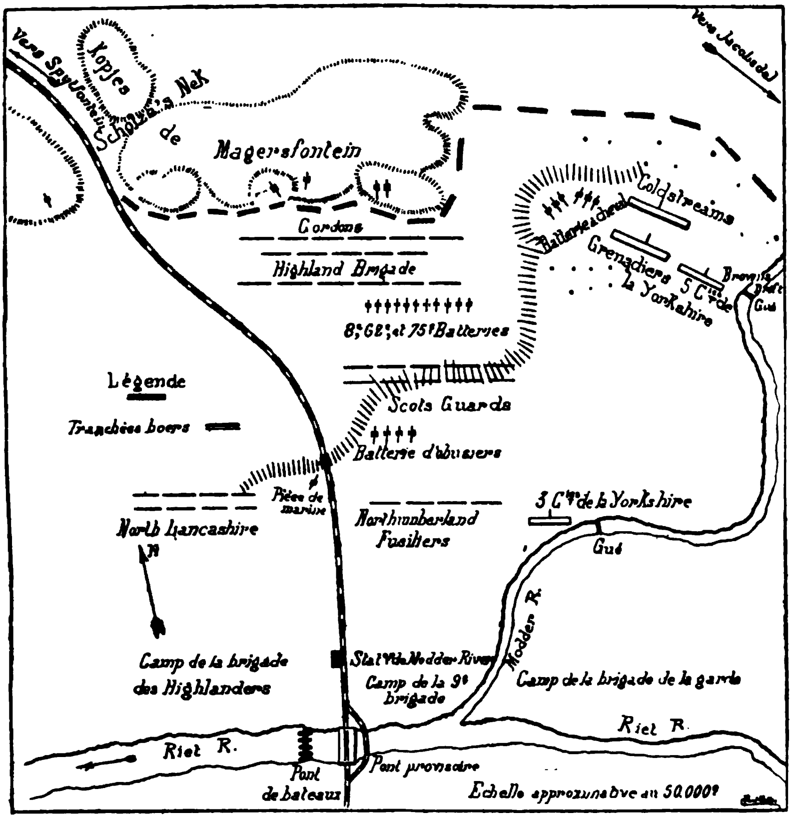
jes trend obliquely so that the open ground is like a wedge with Spytfontein at the apex, and Jakobsdal at one end of the base. The Magersfontein Kopjes constitute this portion of the Boer line. They rise to a height of 150 feet.

The Boer trenches ran along the foot of the heights they occupied, to the right of the British advance, then over the kopjes into the open country, so that a wide detour would have been necessary to turn them. But there was no thought of this, Lord Methuen's plan evidently being to surprise the position and attack in front only, nor was it known to the British that the Boer trenches lay along the foot of the hills, otherwise the artillery fire would not have been directed on the heights.

In the early dawn of December 11th the Highland brigade, still in closed column arrived within 500 yards of the enemy's trenches, having just passed a wire entanglement (at about 650

yards from the enemy) and reached a perfectly open terrain. Just as the order to deploy for attack was given the enemy opened fire, and so murderously that the Highlanders broke and fell back in disorder with fearful loss. General Wauchope fell among the first. The brigade was re-assembled a few hundred yards to the rear, but its spirit was broken.

The Guard Brigade was then deployed, but could make no headway, and finally the whole of Lord Methuen's force was engaged,—except a battalion of Gordon Highlanders left in reserve




BATTLE OF MAGERSFONTEIN.—*Rev. du. Cercle.*

and to take charge of the train,—the Guards on the right, Carew's brigade and the artillery in the center, the Highlander brigade on the left. The howitzers on the left fired Lyddite shell at about 3,800 yards range, while the three light batteries in the center advanced to within 1,700 yards of the Boer trenches, and the horse batteries moved to the right of the light batteries.

The Boers accupied the road towards Jakobsdal as well as the trenches at the foot of the heights.

The Highlanders not being available for another attack, the reserve (Gordon Highlanders) was ordered up, and arrived about 9 A. M., taking position in front of Wauchope's brigade, the two battalions of the Coldstream Guards strengthened the right wing, and the Grenadier Guards were detached to cover the extreme right flank. The howitzers advanced about 1,000 yards nearer. The field batteries were then about 1,200 yards, the howitzers 2,700 yards and the horse batteries about 1,600 yards from the enemy. But nothing availed. The Boers worked continually around towards the British right.

The Yorkshire Light Infantry had ascended the Modder during the night and occupied at daybreak a ford about 3 miles north-east of the bridge; after leaving 3 companies at this ford, the 5 others were sent to Brown's Drift, further north. This force protected Methuen's exposed right flank during the entire day, and foiled Cronje's attempts to take the British lines in flank.

At about 2 P. M. the Highlanders were again demoralized and fell back in disorder, but were assembled, and, supported by the Scots Guards, took up their position again near the guns.

At about 5.30 P. M. the enemy's guns (which had remained silent up to this time) opened fire on the ammunition train and the cavalry. The Highlander Brigade again broke and fell back to the field hospital. Another attack was therefore not to be thought of. The British forces bivoucked on the field, and in the morning began their retreat, falling back again to the Modder River.

During the day the balloon section made several ascents, remaining up each time about ten minutes.

General Methuen's advance was in reality a forced reconnoissance, for nothing was known of the enemy's strength or exact position. He made the great mistake of allowing an interval of several hours to elapse between his artillery combat and his infantry attack, and in the latter he brought his forces into action successively, consequently without definite result.

General Wauchope, commanding the Highland Brigade, was killed, and General Hector Macdonald succeeded him.

Again we find that the British, in their anxiety to surprise the Boers, neglected all measures for security and information, and were themselves surprised. Lord Methuen lost about 1,000 men, or one-ninth of the forces actually engaged.

The British lost 21 officers and 139 men killed, 48 officers and 624 men wounded, 3 officers and 121 men missing, or a total of 956. The Boers lost 219.

The Highlanders lost about 25.4 per cent. of their entire force in ten minutes, and the brigade was placed *hors de combat* for the day. The *Black Watch* lost over 37 per cent. It has been stated by several authorities that in the battles of the future the losses of the army will probably not exceed 20 per cent, although, of course, particular units will be subjected to severer losses.

The battle was really lost in those ten minutes in which the Highlanders suffered their great losses, and it is clearly evident that nothing but imperfect reconnoissance is to blame for the British reverse in this case.

How General Methuen could decide to cross the Modder River and advance when he had left a Boer force on the south bank of the Riet, in his flank and rear, is inexplicable.

Before the close of the year but few further movements took place in the western and southern sections of the theatre of war, and none of any importance. On December 13th General French with the 6th Dragoon Guards, the 10th Hussars and 4 horse artillery guns forced back a commando of Boers, about 1,800 strong, north of Naawpoort; and again on the same day, his mounted infantry drove back a column of Boers from Zoutpans Drift, 10 miles east of Orange River. On December 25th Dordrecht was occupied by Colonel Dalgety, and on the 31st there was a small skirmish near this place.

## THE CAMPAIGN IN NATAL.

### The First Attempt to Relieve Ladysmith.

### The Battle of Colenso.

General Buller remained inactive until the middle of December. The Boers under General Schalk Burgher (since Joubert's illness) had occupied with 12,000 men and strengthened the Tugela line at Colenso, sending out detachments to close the lines leading to Ladysmith, situated on their flanks: on the right flank the bridges over the Little Tugela at Springfield, and on the left flank the bridge over the Bushman river at Weenen, and the Tugela bridge in rear. In rear of Springfield they occupied a strong position on Zwarts Kop.

At Colenso the principal Boer position was north of the river, but they had also occupied the southern bank east of the railroad, resting their left flank on the Hlangwane Hill. From this last position they could take an enemy crossing at Colenso in rear,

cut him off, and take him under cross-fire. General Buller appears not to have been aware that this hill was occupied.

The country between Colenso, Frere and Springfield is without roads and very hilly, and that between Colenso, Weenen and Estcourt is also without roads and has the obstacle of the Blaauwkraas river besides. Moreover, to move on either of the flanks of the Boer position necessitated abandoning the railroad. Finally, such a movement in either direction would subject the British to flank attack from Colenso, and in addition the distance from Colenso to Springfield or to the Tugela bridge north of

WRECK OF THE BRIDGE AT FRERE.

Weenen is shorter than the distance from Frere to either of these objectives.

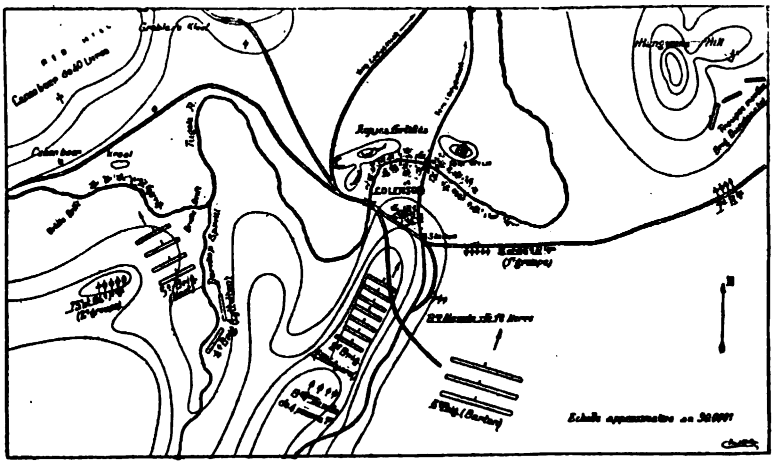
The railroad bridge just north of Colenso had been destroyed; the road bridge about 600 yards above remained, but was mined; there was a ford between the two bridges and one just above the road bridge. These were the only points where the river could be crossed without constructing a bridge, and they were, of course, strongly defended by the Boers. Moreover, just below Colenso, where the river makes a sharp turn to the North, the Boers had crossed to the south bank and occupied the Hlangwane hill, commanding the Colenso-Weenen road, and threatening the

One Span for New Railway Bridge at Colenso.

river crossings from the eastward; and on the west they had continued their lines on the south bank, flanking the upper ford and the space between the bridges; finally, Colenso itself was occupied by the Boers.

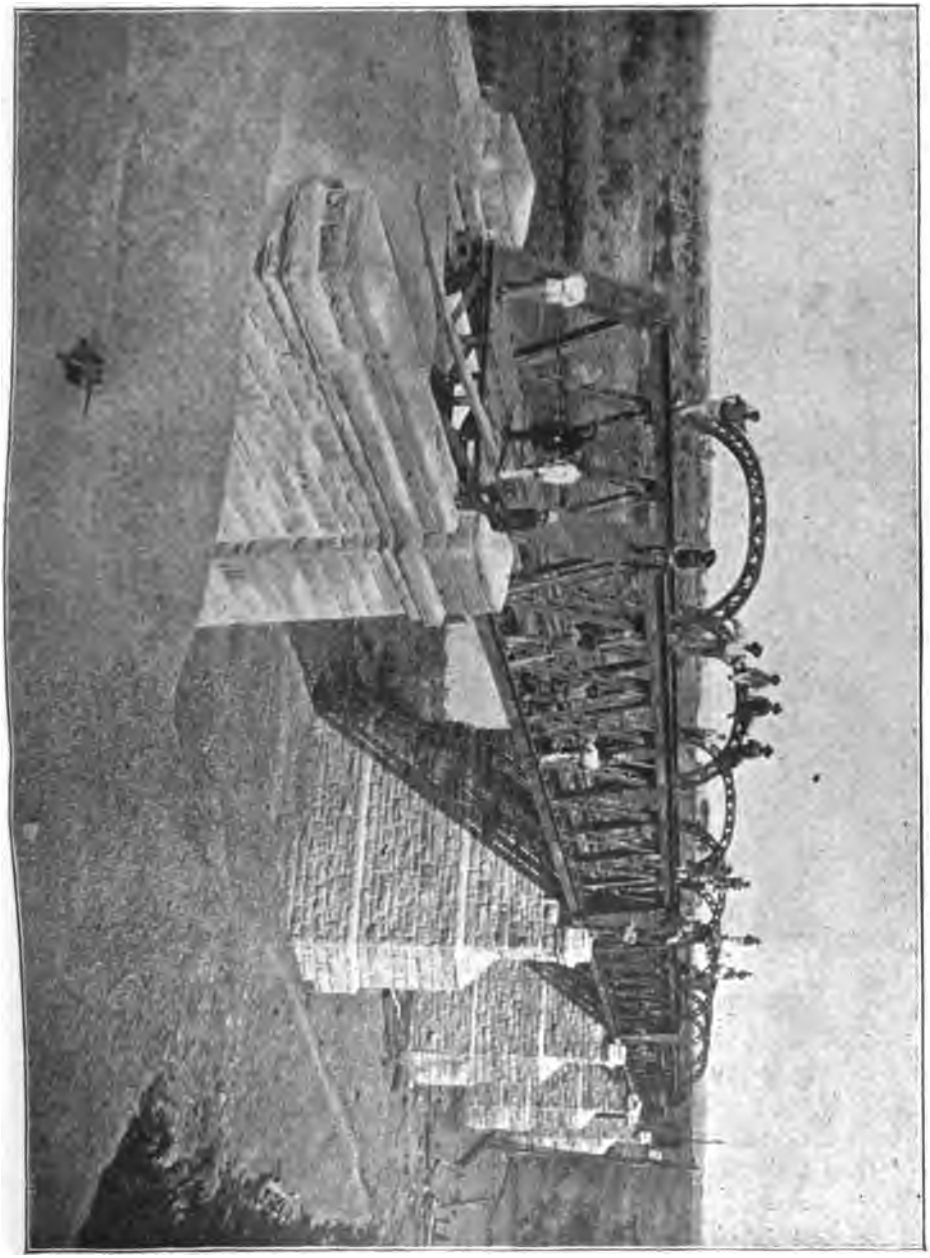
General Buller had at Chieveley and Frere about 19,000 men and 52 guns. His plan was to first force the Bridle Drift (upper ford), and if successful the troops crossed there would facilitate the passage of the other columns at the iron bridge. If unsuccessful the troops would hold the enemy in their immediate front while the right wing forced the passage of the iron bridge.

On the evening of December 14th and the morning of December 15th, General Buller prepared for his advance from Chievely camp by bombarding the supposed Boer positions by means of



BATTLE OF COLENSO.—*Cercle.*

the naval guns and the howitzer batteries. On the 15th the advance was begun, Hildyard's brigade moving on the lower ford, Littleton's through Colenso on the road bridge, Hart's brigade on the upper ford. At 4.45 A. M. the navy 4.7-inch guns opened on Fort Wylie, and at 6 A. M. the 14th and 66th batteries advanced to the east of the railroad and came into position at 750 yards from the Tugela (about 1,200 yards in front of the infantry). The battery of naval 12-pounders came up on the left and rear of the field guns. The Boers opened on the field guns not only with their artillery but also with infantry fire from the trenches at short range, and the field batteries, under cross-fire from the front and from Hlangwane Hill, were soon destroyed and had to be abandoned.



ORIGINAL RAILWAY BRIDGE AT COLENSO.

Meanwhile the infantry attack began.

Littleton's brigade and part of Hildyard's were held in check by the garrison of Colenso, while Hart's advanced towards the upper ford. The troops were still in column when they found themselves under a cross-fire from the Boer trenches on the north and the south banks, as well as under artillery fire, and although they continued to advance and even succeeded in getting a few men to the other side, they lost heavily and were compelled to fall back, and joined the part of Hildyard's brigade which had passed the eastern edge of Colenso and was advancing on the lower ford. But then they received the flank fire of the Boer trenches on the north bank, and the artillery fire from the Hlangwane Hill. Buller sent his entire cavalry and the mounted infantry against Hlangwane hill, but the British artillery could

TEMPORARY BRIDGE AT FRERE.

take up no good position against the longer range Boer guns; and the cavalry and mounted infantry could make no progress. Finally, in consequence of the loss of the artillery, the troops fell back in disorder towards Frere.

This is known as the Battle of *Tugela River*, or the Battle of *Colenso*.

The British lost about 900 killed and wounded, and 11 guns: 9 officers, 137 men killed, 42 officers and 699 men wounded, 200 missing.

The Boers in the trenches in this locality were commanded by Botha, and numbered only about 2.000 men.

The causes of these reverses on the Tugela are but too apparent. While Buller was still at Frere station his advance guard was directed on December 12th to reconnoiter as far as Chieveley, and the presence of Boer forces south of the Tugela (between it and the Blaaukraas river) was then established. Notwithstanding this, Buller advanced on the 15th to attack the Tugela line without making any attempt to determine the strength and position of these forces. It is not surprising, therefore that he met with surprises, flank attacks and cross-fires. Moreover, it is an established principle that to cross a river in the face of a prepared enemy it is necessary first of all to obtain full possession of the nearer bank, and Buller's neglect of this condition still further explains the results.

It is remarkable that during the long period of inaction Buller should have taken no measures to obtain, by careful reconnoisance, a clear insight into the strategic situation. Had he done so he would have seen that an advance on Colenso laid him open to being cut off, by an advance of the Boers at Springfield and Weenen against his lines of communication, which would have put him into the same plight as White at Ladysmith. But, after neglecting all proper reconnoissance, that he should advance to the attack without properly securing his flanks, is simply incomprehensible.

The first condition for forcing the passage of the Tugela was the capture of the Hlangwane hill and the expulsion of the Boers from the trenches on the south bank. But apparently the British did not even know that these points were occupied in force.

In the face of these disasters England ordered out all her reserves, proceeded to mobilize the 8th Division, and appointed Field Marshall Lord Roberts commander-in-chief in South Africa, with General Lord Kitchener of Khartoum as second in command. The total losses of the British up to this time (not including deaths from disease) were 7,630.

### COMMENTS.

Let us review briefly the causes of the events up to the present :

The main causes of the late disasters to the British arms in South Africa are readily traceable to grave mistakes made early in the campaign, and now difficult to remedy. Minor errors have marked the course of the operations, but they were due largely to haste and a natural desire to overcome by extraordinary exer-

tions the difficulties of a situation which was rendered dangerous by the earlier and graver errors in training, preparation, recruitment, material, organization, strategy and tactics.

First, as regards strategy. The wedge of Natal, projecting as it does into the Boer country, would appear at first sight to offer the great advantage of enabling an army always to operate on interior lines. With such a position a comparatively small force is able to fall on the fractions of the enemy, as his separate columns cross the passes of the border, and destroy them in turn. But in order to do this the force in the wedge must be at least stronger than any one of the enemy's columns. The only way the British could have taken full advantage of their advantageous position would have been by concentrating their forces at some one point just north of Ladysmith; instead they divided them into two forces, one at Glencoe-Dundee, the other at Ladysmith. The result was, when White moved out from Ladysmith to prevent the union of two of the Boer columns coming over the mountains, he had but 3,000 men available, which was much below the strength of either of the Boer columns. If the troops had been concentrated in one place he would have had 10,000 men available, a number which would have been far greater than either Boer column.

In the defense of Dundee and Ladysmith the British showed too great a tendency to be tied down to localities, when the only proper course would have been to retire before superior forces, and try to hold the Pietermaritzburg-Durban railroad, so important as a line of advance. Their tenacity and pluck in defending the places referred to are to be commended as such, but, although inspired by quite a different motive from that which induced Bazaine to hold on to Metz in 1870, the ultimate effect on the general situation was similar. The same may be said of the defence of Mafeking and Kimberley. Instead of adding to the strength of the British attacking forces they weakened the strategic plan, because there can be little doubt that Buller's subsequent movements were greatly influenced by the desire to relieve these besieged garrisons, whereas had they retired they would now be available to assist the advancing columns, instead of being held in check.

Turning now to Gen. Buller's plan of campaign, he seems, at first sight, to have followed good strategic principles in dividing into two main columns, one over Durban-Estcourt, the other over Cape Town-Orange River station, concentrating on the Boer country, with Pretoria as the ultimate objective. But, if we

examine more closely, we find that the total strength of his command does not warrant any division, because neither column is strong enough to cope with the enemy immediately in its front or to keep up proper communication between the far separated columns for effective mutual support or combined action. His entire force should have been sent to Durban and concentrated on the main Boer army in Natal, if rapid and decisive results were expected. Of course, the desire to relieve the garrisons at Kimberley and Mafeking had a great influence, and no doubt the strength and ability of the Boers were greatly underrated, but judgment and decision on such points are factors in generalship and constitute the elements of strategy.

Although these early battles prove the high quality of the British soldier in battle, they also indicate a lack of mobility, and a too great dependence on their base of supply, especially the railroad.

Secondly, as regards training. The best training is, of course, actual war, but the late wars of the British have not been of a character to teach them what an active and well-trained enemy is liable to do on the battlefield. Next to actual war come field exercises or manœuvres, and it appears from what the British officers themselves say that this kind of peace training was inadequate, first, in that it did not include on a sufficiently large scale flanking movements by the troops representing the enemy; secondly, in that the manœuvres were not conducted on a scale sufficiently extensive to make the officers familiar with the handling of large bodies of troops on the battlefield. The former explains why the British are continually surprised by the flanking movements of the Boer lines, and the latter may account for some of the tactical errors about to be considered.

Thirdly, let us analyze the British tactics. In the early part of the campaign they were very deficient in cavalry, but light infantry, properly trained, especially as opposed to such slow-moving and deliberate enemies as the Boers, should have done excellent service on reconnoissance, notably in the rough country in northern Natal, which is in reality more favorable for infantry than for cavalry scouts. But even later on, when French had an entire cavalry division at Naauw Poort, Gatacre was surprised in his advance from Queenstown. Of course, the British are under the great disadvantage of operating in country where the natives sympathise with the enemy, but this does not satisfactorily explain all the deficiencies in reconnoissance work. For example, even on the battlefield, patrol duty to keep up intercommunica-

tion between the parts of a line seems to have been neglected, as at Nicholson's Nek, where one column of a small command was allowed to get so completely separated as to be captured, never having been informed of the repulse of the adjacent portions of the general line.

The cavalry failed entirely in its reconnoissance work, and the brigade commanders did not take up the work, when the cavalry retired from the front, by advancing their lines of infantry to force the enemy to develop his position.

The defeat of General Buller's army at Colenso appears to be another case in point. It is to-day considered to be no dishonor to lose a battery on the battlefield, provided its sacrifice is demanded by the general situation; but from the official report it appears that when Colonel Long "advanced close to the river in his desire to be within effective range" it "proved to be full of the enemy." Now, the artillery's duty was to get within effective range, but it is someone else's business to see that the bank of the river is not full of the enemy before the artillery is ordered to the front. Again, imperfect reconnoissance appears to be at the bottom of the trouble.

However, there is another point that demands consideration here. For some years the continental armies have been training special artillery scouts, that is, mounted men, selected from the field artillery batteries, whose duty it is to precede a battery, clear up the ground along the road of advance, look up the enemy's position, note points of value to the artillery commander, and report promptly whatever demands reporting, but remain constantly in touch with the enemy. These scouts are usually formed into patrols, under particularly efficient officers or non-commissioned officers. The British field artillery appears not to have put in practice this most effective means of protecting the artillery from surprise.

Another tactical weakness seems to be the failure to occupy positions properly. It is incomprehensible why Dundee Hill (which cost so dear to retake after the Boers occupied it) was not occupied in the first place.

Moreover, the tendency of the British to make simple frontal attacks, is to be condemned as too great a waste of life in these days of enormous strength of the defense. The mistaken ideas of tactics, which induced the British to make such purely frontal attacks, in great measure necessitated that exposure of the officers and men which resulted in such great losses. Wherever

they tried pressure on the flanks (as at Elandslaagte and Riedfontein) they were successful.

It will suffice to pass in rapid review the other elements of weakness.

As regards preparedness it is only necessary to refer to the weak garrisons at Kimberley and Mafeking, guarding the important railroad from Cape Colony to Buluwayo, to the insignificant forces on the Orange River, covering the Port Elizabeth Railroad, and to the comparatively small force at the keystone in Natal at the outset of the campaign. At home, the unreadiness of the Admiralty promptly to transport the reinforcements was severely commented on, and the length of time allowed for recruiting the army corps was probably necessitated by the lack of a full supply of clothing and equipment in the storehouses. The conditions in South Africa demanded prompt relief, and every moment of delay increased the gravity of the situation, as soon became fully apparent.

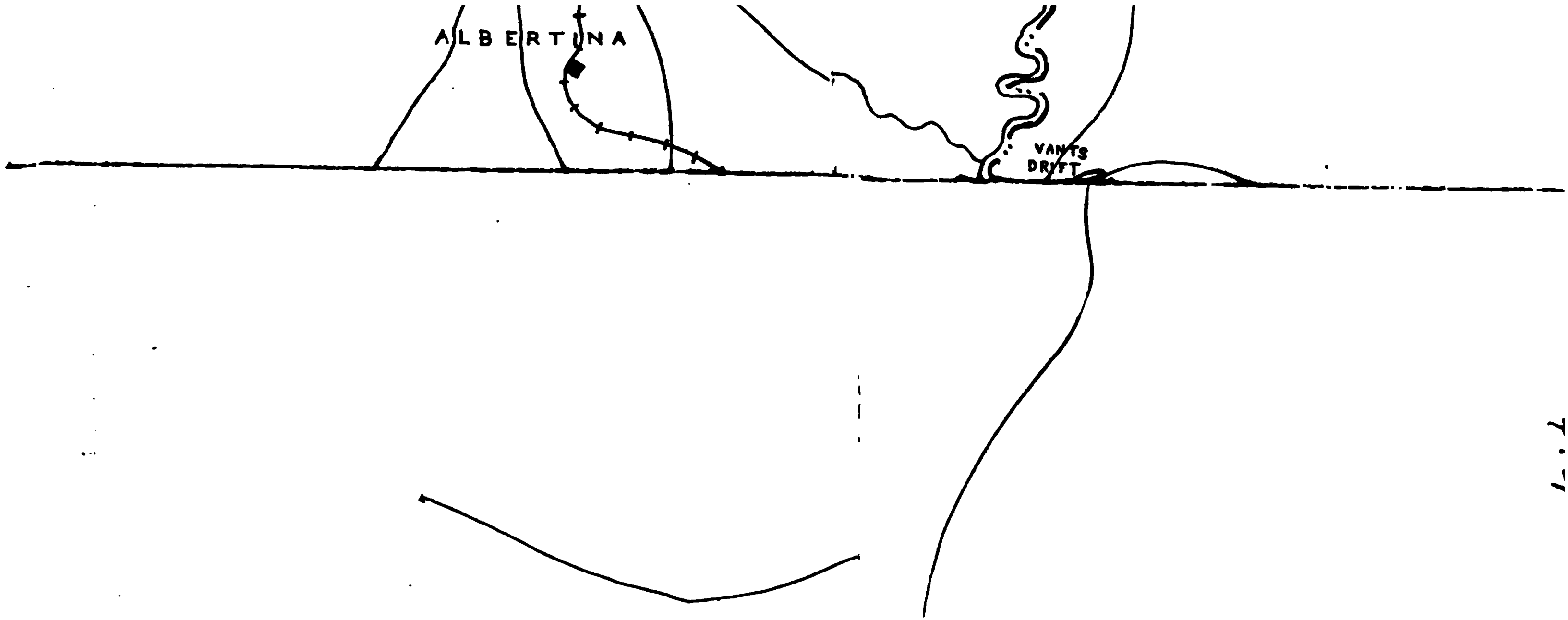
The greater part of the cavalry division of the army corps and the field artillery arrived after the infantry, which was a great disadvantage.

The want of artillery material, both field and siege, in sufficient quantity, made itself felt very early in the war. But this was not due to an actual want of such material at home, only to a deficient organization—the lack of a chief of artillery, who could demand that the proper artillery guns be sent, and who could be held responsible for not having them on hand in time. Another deficiency in organization was the mixing up of the units in the two main armies, by which one brigade of a division would be in one army, another in the other, so that Clery's column had parts of four different divisions.

The chief of all these elements of British weakness is, of course, the strategy of the campaign—the great superiority of the Boers in strategic deployment and strategic advance, due to their unity of plan and action being everywhere manifest. The original inferiority of the British in numbers is also a prime cause ; but each of the other elements has had its effect on the preliminary situation and the subsequent events.

The operations of the Boers are marked by good strategy, and their tactical applications of their forces in battle, especially on the defensive, by considerable skill, but they lacked the spirit of the initiative and the power of the tactical offensive. The attack of the several columns on Dundee was not simultaneous ; at Elandslaagte the advanced force was not properly supported ;

after the battles of Dundee and Elandslaagte their forces became too cautious in their advance and so allowed Yule to escape; they failed to push their advantage and to attack Ladysmith vigorously in the proper direction, before the British could have time to strengthen their position, but preferred to occupy a strong position to the north of the town; and finally, after the battle of Colenso, they failed to pursue.


ALBERTINA
VAN'S DRIFT

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## APPENDIX.

DISTRIBUTION OF THE BRITISH FORCES AT THE END OF NOVEMBER, 1899.

**Ladysmith.**

*General White.*

10,000 men, 44 (36 field, 8 navy) guns, 12 machine guns.

**Natal.**

*General Clery.*

15,500 men, 24 field guns, 16 machine guns.

**Modder River.**

*General Lord Methuen.*

9,400 men, 22 field guns, 12 machine guns.

**Kimberly.**

*Colonel Kekewich.*

2,400 men, 12 field guns, 4 machine guns.

**Mafeking.**

*Colonel Baden-Powell.*

1,000 men, 6 field guns, 4 machine guns.

**Naauwpoort and De Aar.**

*General French.*

4,900 men, 6 field guns, 6 machine guns.

**Queenstown.**

*General Gatacre.*

4,300 men, 5 machine guns.

**Rhodesia.**

1,000 men, 6 field guns, 4 machine guns.

**Cape Town.**

3,500 men, 35 field guns, 2 machine guns.

The strength of the forces in South Africa after the arrival of the mobile army corps was as follows :—

| | Officers and men. | Horses. | Mules. |
|---|---|---|---|
| 6 Infantry Brigades | 25,674 | 408 | 5,244 |
| 3 Divisional Troops | 3,579 | 2,289 | 1,119 |
| 2 Cavalry Brigades | 5,370 | 4,894 | 2,282 |
| Corps troops | 5,124 | 2,584 | 1,938 |
| Cavalry Division Staff | 42 | 38 | 33 |
| Field Engineer Troops with the Cavalry | 122 | 88 | 51 |
| Total of Mobile Army Corps | 39,911 | 10,301 | 10,667 |
| Troops for Lines of Communication | 9,387 | 885 | 2,683 |
| Natal Force | 14,628 | ...... | ...... |
| Cape Force | 5,140 | ...... | ...... |
| Naval Brigade | 1,000 | ...... | ...... |
| | 70,066 | 11,186 | 13,350 |

The actual strength of the mobile army corps in line troops, exclusive of the Staffs, was:

| | |
|---|---|
| Infantry | 25,475 |
| Mounted Infantry | 1,172 |
| Cavalry | 4,252 |
| Artillery | 3,435 |
| Total | 34,334 and 114 guns. |

The infantry arm is the Lee-Metford rifle of 0.3-inch caliber, the cavalry arm is the Lee-Metford carbine of the same caliber, the field batteries have 15-pounder guns, the horse batteries 12-pounders, the mountain batteries 7-pounder guns and the howitzer batteries 5-inch guns.

The transports landed their first troops on November 12 at Cape Town, part being sent on to Durban. The following were sent on to Natal:

1st Brigade: 2d Coldstream Guards.
2d Brigade (Major General Hildyard):
2d West Surrey Regiment.
2d West Yorkshire Regiment.
2d East Surrey Regiment.
6th Brigade: 1st Royal Welsh Fusiliers.
2d Irish Fusiliers.

Also parts of the 2d Division and 3 field batteries. Major General Clery (commanding 2d Division) was sent as commander-in-chief in Natal.

Lord Methuen (commanding 1st Division), was sent to Orange River station with the following:

3d Grenadier Guards.
1st Coldstream Guards.
1st Scots Guards.
1st Northumberland Fusiliers.
1st Royal Munster Fusiliers.
½ 1st Royal North Lancashire Reg't.
9th Lancers (Embarked at Calcutta and Bombay, Sept. 29).
Field Artillery.

The rest of the mobilized army corps (1st, 2d and 3d Divisions) embarked in the first and second week of November, and arrived early in December. White's troops at Ladysmith constitute the 4th Division.

### NEW ORGANIZATIONS.

The 5th Division was ordered mobilized on November 8th and has the following composition:

#### FIFTH DIVISION.

General Sir C. Warren.

| 10th Brigade. Major General Coke. | 11th Brigade. Colonel Woodgate. |
|---|---|
| 2d battal. Royal Warwickshire Reg't. | 2d battalion Royal Lancaster Reg't. |
| 1st battalion Yorkshire Regiment. | 2d battalion Lancashire Fusiliers. |
| 2d battalion Dorsetshire Regiment. | 1st battalion South Lancashire Reg't. |
| 2d battalion Middlesex Regiment. | 1st battal. York and Lancaster Reg't. |
| Army Service Corps (Co. No. 32). | Army Service Corps (Co. No. 25). |
| Litter Bearer Co. No. 10. | Litter Bearer Co. No. 6. |
| Field Ambulance No. 11. | 1 Field Ambulance. |

1 Squadron, 14th Hussars.
19th, 20th and 28th Field Battery.
Ammunition column.
Field Engineer Co. No. 37.

Army Service Corps (Co. No. 12).
Field Ambulance No. 15.

Total strength 11,000 men, 1263 horses, 18 field guns, 9 machine guns.
Embarkation, the end of November on fast steamers.

| | |
|---|---|
| Not yet Brigaded: | 1st King's (Liverpool). |
| | 2d King's Royal Rifle Corps. |
| | 2d Rifle Brigade. |
| | 1st Border Regiment. |

In addition to the 5th Division the following troops were ordered to proceed to South Africa:

Three infantry battalions, the 1st Suffolk (from Dover), 1st Essex (from Warley), 1st Sherwood Foresters (from Malta) and 1st Derbyshire battalions were ordered to replace the Gloucester and Irish Fusilier battalions captured at Ladysmith.

The 4th mountain battery to replace the captured 10th.

A regiment of Household Cavalry.

A siege train of 30 howitzers (14 six-inch, 8 five-inch and 8 four-inch) and 1,000 men.

On December 3d the mobilization of the 6th Division was ordered, beginning on the 4th and ending on the 11th of December. On the 16th the transportation to South Africa was begun, and the first troops would reach Cape Town about January 8th, or Durban about January 12th.

SIXTH DIVISION.

Major General T. Kelly-Kenny.

| 12th Brigade. Colonel Clements. | 13th Brigade. Colonel Knox. |
|---|---|
| 2d battalion Bedfordshire Regiment. | 2d battalion East Kent Reg't (Buffs). |
| 1st battalion Royal Irish Regiment. | 2d battalion Gloucestershire Reg't. |
| 2d battalion Worcestershire Reg't. | 1st battalion West Riding Regiment. |
| 2d battalion Wiltshire Regiment. | 1st battalion Oxfordshire Light Infantry Regiment. |
| Army Service Corps (Co. No. 7.) | Army Service Corps (Co. No. 10). |
| Litter Bearer Co. No. 8. | Litter Bearer Co. No. 7. |
| Field Ambulance No. 4. | Field Ambulance No. 18. |

76th, 81st and 82nd field battery.
Ammunion column (1 reserve gun).
Field Engineer Co. No. 38.
Army Service Corps (Co. No. 23).
Field Ambulance No. 6.

Total strength: 9,601 men, 744 horses and 2,405 mules.

On December 14th the mobilization of the 7th Division was ordered. Its embarkation took place between the 4th and 10th of January, and it reached the Cape about the end of January.

SEVENTH DIVISION.

Major General C. Tucker.

| 14th Brigade. Major General Chermside. | 15th Brigade. Major General Wavell.* |
|---|---|
| 2d battalion Norfolk Regiment. | 2d battalion Cheshire Regiment. |
| 2d battalion Lincolnshire Regiment. | 1st battalion East Lancashire Reg't. |

* General Prior, first assigned, died at Aldershot.

1st battalion King's Own Scottish Borderers.
2d battalion Hampshire Regiment.
Army Service Corps (Co. No. 31).
Litter Bearer Co. No. 19.
Field Hospital No. 13.

2d battalion South Wales Borderers.
2d battalion North Staffordshire Regiment.
Army Service Corps (Co. No. 12).
Field Ambulance No. 13.

83d, 84th and 85th field batteries.
Ammunition column (1 reserve gun).
Field Engineer Co. No. 9.
Army Service Corps Co. No. 17.
Field Hospital No. 13.

No cavalry is assigned to this division: hereafter volunteer mounted infantry is to be attached, about 880 men to a division.

On December 17th Field Marshall Lord Roberts was appointed commander-in-chief in South Africa, with Lord Kitchener of Khartoum as his chief of staff.

The government, about the middle of December, ordered the organization of the following for service in South Africa:

1. Imperial Yeomanry, 3,000 men (selected Yeomanry as mounted infantry). The companies to have a strength of 5 officers and 110 men.
2. Volunteer Mounted Infantry, 76 selected companies, one for each battalion to be sent out in future, 8,664 in all. A second selected company to be made up in the regimental district of each regiment.
3. A battalion of volunteers from the metropolis:
   City of London Imperial Volunteers. 1,400 men.
   8 companies Infantry.
   2 companies Mounted Infantry.
   1 battery field artillery (4 Q.F. guns).
4. The 16th Lancers and 2,000 reserve horses from India.
5. 700 men of the naval brigade landed.
6. A field howitzer battalion of 3 batteries of 6 guns each. 43d, 86th and 87th batteries.

The 8th Division was ordered mobilized towards the end of December.

EIGHTH DIVISION.

Major General Sir H. Rundle.

16th Brigade.
Major General B. B. D. Campbell.

2d battalion Grenadier Guards.
2d battalion Scots Guards.
2d battalion East Yorkshire.
1st battal. Leinster (Royal Canadians) [from Halifax.
Army Service Corps.
Litter Bearer Co. No. 21.
Field Hospital No. 21.

17th Brigade.
Major General J. E. Boyes.

1st battalion Worcester.
1st battalion Royal West Kent, from [Cairo.
1st battalion South Stafford, from [Gibralter.
2d battalion Manchester.
Army Service Corps (Co. No. 37).
Litter Bearer Co. No. 22.
Field Hospital No. 22.

89th, 90th and 91st field batteries.
Ammunition column (1 reserve gun).
Field Engineer Co. No. 5.
Army Service Corps (Co. No. 39).
Field Hospital No. 23.

Each battalion has a strength of 1,019, in which is included for each a mounted company.

A Cavalry Brigade was ordered mobilized at the same time with the 8th Division.

CAVALRY BRIGADE.

Major General J. B. B. Dickson.

7th Dragoon Guards.
8th Hussars.
17th Lancers.
Horse Battery M.
Ammunition column (1 reserve gun).
2 Companies Mounted Infantry.
Army Service Corps (Co. No. 3).
1 Company Bearers.
1 Field Hospital.

Total strength 2,518 men, 2,160 horses, 7 field guns, and 2 machine guns.

An artillery corps was ordered to mobilize at the same time as the 8th Division.

ARTILLERY CORPS.

12th howitzer battalion: 43d, 86th and 87th batteries.
13th battalion: 2d, 8th and 44th field batteries.
14th battalion: 39th, 68th and 88th field batteries.
15th battalion: 5th, 9th and 17th field batteries.

Total strength 2,630 men, 2,134 horses. Each howitzer battery has 199 men, 162 horses; each field battery 175 men, 137 horses.

The following separate organizations have been ordered to South Africa:

1st battalion Cameron Highlanders (from Cairo).
1st battalion Sussex (from Malta).
2 battalions from Gibralter.
16th Lancers from India (sailed January 8).
Horse batteries A and J from India.

NINTH BRIGADE.

1st Northumberland Fusiliers.*
1st Loyal North Lancashire* (part).
2d Yorkshire Light Infantry.*
2d Northamptonshire.†

COLONIAL FORCES.

**Rhodesia.**

Rhodesia Horse (one squadron in Natal).
Protectorate Regiment (under Colonel Baden-Powell).
Mounted Infantry (under Colonel Plumer).

**Kimberley.**

Diamond Fields Artillery.
Kimberley Light Horse.
Kimberley Rifles.

**Cape Colony.**

South African Light Horse (under Col. Byng and Capt. Villiers).
Imperial Corps of Guides.
Brabant's Horse.
Warren's Horse.
De Montmorency's Scouts.
Railway Engineer Corps.
Mounted Volunteers (Colonel Cole).

* Originally in Cape Colony Force. † Originally on Line of Communications.

Prince Albert Cape Artillery.
Cape Garrison Artillery.
Victoria Rifles.
Cape Town Highlanders.
Prince Albert Guard of Port Elizabeth.
Kaffrarian Rifles of East London.
Grahamstown Volunteers.
Queenstown Rifle Volunteers.
British South African Police (Colonel Walford).
Cape Mounted Rifles Police (Colonel Dalgety).

**Natal.**

Amounted to 4,500 men in November, 1899.

| | |
|---|---|
| Imperial Light Horse. | Natal Mounted Rifles. |
| Uitlander Regiment. | Border Mounted Rifles. |
| Imperial Infantry. | Umvoti Mounted Rifles. |
| Bethune's Horse. | Corps of Colonial Scouts. |
| Natal Carabineers. | Corps of Guides. |
| Natal Field Artillery. | Natal Mounted Police. |

**Canada.**

Royal Canadian Regiment of Infantry.
Canadian Mounted Rifles (2 battalions).
Royal Canadian Artillery. Batteries C, D, E, (12-pounder B.L.)

**Australia.**

| | |
|---|---|
| New South Wales Lancers Squadron | 80 |
| New South Wales Infantry | 120 |
| New South Wales Mounted Rifles | 75 |
| Queensland Mounted Infantry | 264 |
| Victoria Mounted Infantry | 250 |
| South Australia Mounted Infantry | 125 |
| West Australia Mounted Infantry | 125 |
| Tasmania Mounted Infantry | 80 |
| | 1,119 |

**New Zealand.**

| | |
|---|---|
| Mounted Infantry | 213 |

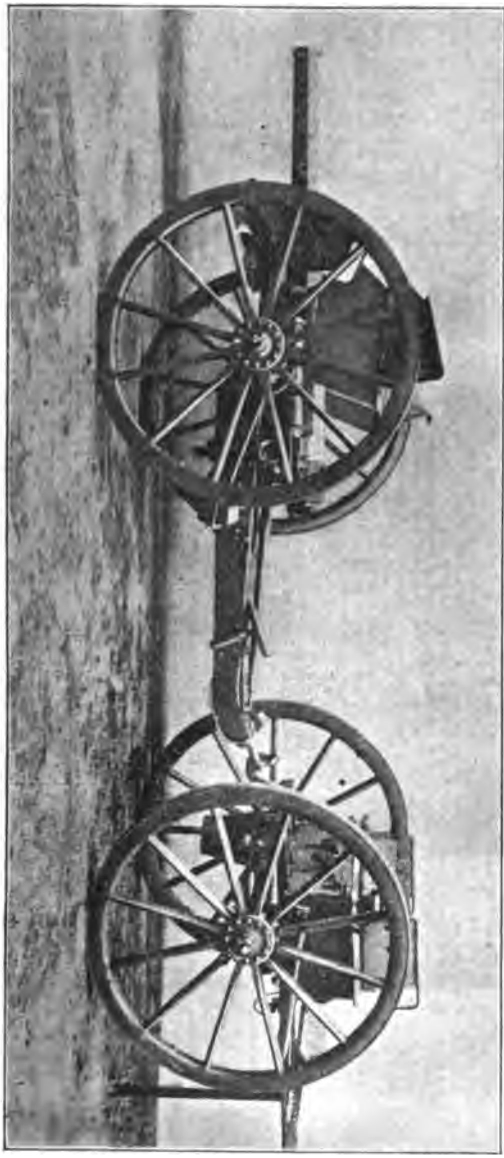
GENERAL BULLER'S COMMAND.

December 14, 1899.

| 2d Brigade. General Hildyard. | 4th Brigade. General Lyttleton. |
|---|---|
| 2d battalion Royal West Surrey Reg't. | 1st battalion Rifle Brigade. |
| 2d battalion Devonshire Regiment. | 3d battalion King's Royal Rifles. |
| 2d battalion West Yorkshire Reg't. | |
| 2d battalion East Surrey Regiment. | |

| 6th Brigade. General Barton. | Mixed Brigade. General Hart. |
|---|---|
| 2d battalion Royal Fusiliers. | 2d battalion Cameronians (Scottish Rifles). |
| 2d battalion Royal Scots Fusiliers. | 1st battalion Durham Light Infantry. |
| 1st battalion Royal Welsh Fusiliers. | 1st battalion Highland Light Infantry. |
| 2d battalion Royal Irish Fusiliers. | 2d battalion Somerset Light Infantry. |

2 field batteries and 6 naval guns.



VICKERS 12.5 PDR. FIELD GUN. CITY OF LONDON VOLUNTEERS.

MAFEKING.

Colonel Baden-Powell.

| *Cavalry.* | *Infantry.* |
|---|---|
| Cape Mounted Police. | Protectorate Regiment. |
| | Volunteers. |
| | B. S. A. Companies, Mounted Police. |

TULI.

Colonel Plumer.

KIMBERLEY.

*Cavalry.*

Cape Police.
Diamond Field Horse (part).
Kimberley Light Horse (part)

*Infantry.*

2d Royal Highlanders (detachment).
1st Loyal North Lancashire (4 comp'ys).
Local Volunteer Corps.
Townsmen.

*Artillery.*

Field Batteries.
Garrison Artillery.
Diamond Fields Artillery.

*Engineers.*

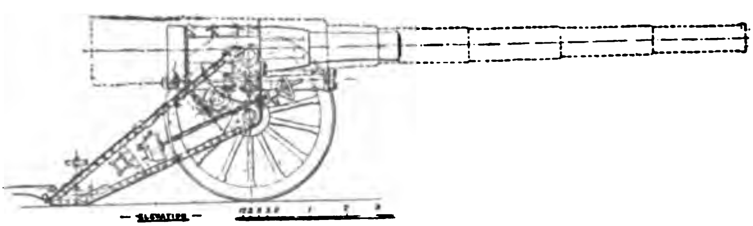
1 Detachment.
R. A. M. C.
Hospital.

British Field Gun with Clarke Recoil Brake.

**British Artillery.**

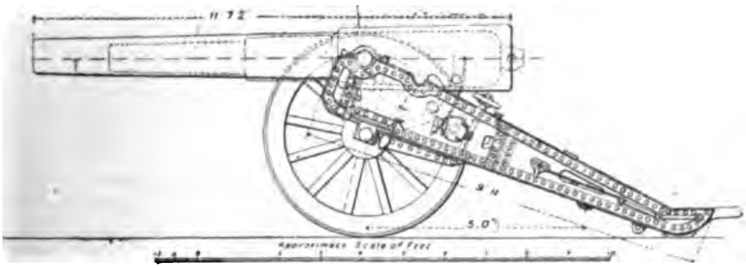
At the end of the year 1899 the British had in South Africa (ommitting those lost in battle) the following artillery material :—

| | Guns. |
|---|---|
| 4 batteries (G, O, P, R) Royal Horse Artillery, 6 guns each, 12-pounder, 3-inch, breech-loaders ............ | 24 |



4.7-in. Q. F. Navy Gun, on 6-in. Howitzer Carriage.

| | |
|---|---|
| 24 batteries (Nos. 4, 7, 13, 14, 18, 19, 20, 21, 36, 42, 49, 53, 62, 64, 66, 67, 69, 73, 74, 75, 76, 77, 79, 92) Royal Field Artillery, 6 guns each, 15-pounder, 3-inch breech-loaders. | 144 |
| 3 batteries (Nos. 37, 61, 65) Royal Field Artilery, 6 guns each, 5-inch fiield howitzers, firing shrapnel, canister and Lyddite shell. | 18 |
| 1 mountain battery (No. 4), 6 guns, 2.5-inch, muzzle loaders. | 6 |
| | 192 |



British 4.7-in. Navy Gun on 40 Pdr. Carriage.

**The Artillery of the Transvaal Boers.**

Old Guns.

| | |
|---|---|
| 8 cm. field guns, Krupp, old | 40 |
| 6 cm. mountain guns, Krupp, old | 40 |
| | 80 |
| 7-pounder R.F. Maxim-Nordenfeldt } Captured in | 1 |
| 3-inch R.F. Maxim-Nordenfeldt } Jameson Raid. | 1 |

New Guns.

| | |
|---|---|
| 7.5 cm. R.F. Krupp field guns, new | 8 |
| 7.5 cm. R.F. Schneider-Canet field guns, new | 16 |
| 7.5 cm. R.F. Maxim-Nordenfeldt field guns, new | 4 |
| 3.7 cm. Automatic Maxim-Nordenfeldt guns, new | 24 |
| 12 cm. field howitzers, Krupp, new | 4 |
| 12 cm. field howitzers, Schneider-Canet, new | 4 |
| 3.7 cm. R.F. mountain guns, Krupp, new | 4 |
| Dynamite Gun (like Simms-Dudley), new | 1 |
| 15.5 cm. long siege guns, Schneider-Canet, new | 4 |
| | 71 |

Machine Guns.

| | |
|---|---|
| 0.45-inch Maxim guns | 30 |
| 0.30-inch Maxim guns | 20 |
| | 50 |

**The Artillery of the Orange Boers.**

| | |
|---|---|
| 7.5 cm. field guns, Krupp | 12 |
| 3.7 cm. field guns | 1 |
| Field guns | 13 |

| | |
|---|---|
| Maxim machine guns | 6 |
| Guns captured by the Boers | 26 |

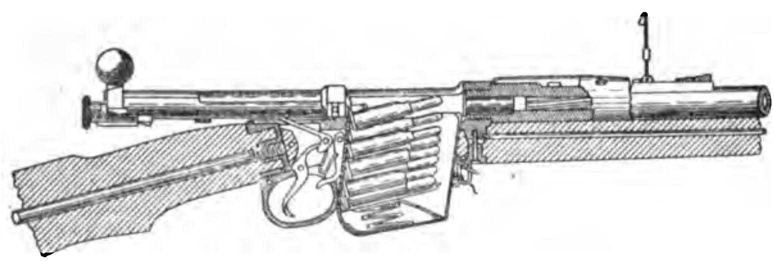
### Small Arms in the War.

British : Lee-Metford gun. Boers : Mauser gun, M 93, 95 and 98. Henry-Martini gun.

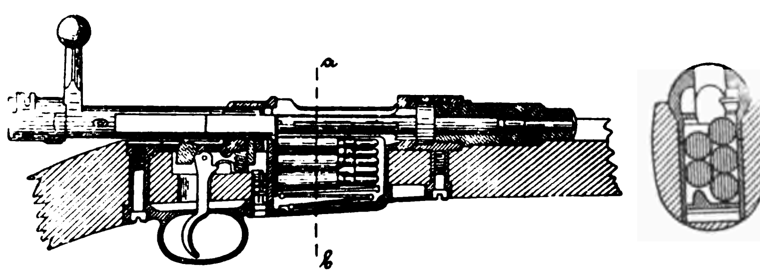
The small arms used in the Boer War are of especial interest to the military world because, in this war small-caliber magazine rifles are used on a large scale for the first time in history.

The arms of the two opposed nations are contrasted in the following table :

| | British. | | Boer. | |
|---|---|---|---|---|
| | Lee-Metford, 89, MII. | Henry-Martini, 95. | Mauser, 93/95. | Henry-Martini (old) |
| Wt. of rifle alone (magazine empty) | 9.2 lbs. | | 8.4 lbs. | |
| Wt. of rifle and bayonet (mag. full) | 10.9 lbs. | | 9.6 lbs. | |
| Length of rifle alone | 4 ft. 1½ in. | | 4 ft. ½ in. | |
| Number of cartridges in magazine | 5 | | 5 | |
| Caliber of bore | 0.303 in. | 0.303 in. | 0.276 in. | 0.45 in. |
| Number of grooves | 5 | 5 | 4 | |
| Mechanism | Bolt. | | Bolt. | |
| Weight of bullet | 14 grams. | 14 grams. | 11.2 grams. | 31.2 grams. |
| Charge | 2.2 grams. cordite. | 2.2 grams. cordite. | 2.2 grams. | 5.5 grams. bl'k powder |
| Total weight of round | 28.3 grams. | 28.3 | 24.8 grams. | |
| Velocity (muzzle) | 2149 f.s. | | 2389 f.s. | |
| Extreme range | | | 4380 yds. | |
| Sight graduated to | 1900 yds. | | | |
| Penetration in deal at 12 m. | 38 in. | | 55 in. | |
| Rounds carried by soldier | 115 | | | |



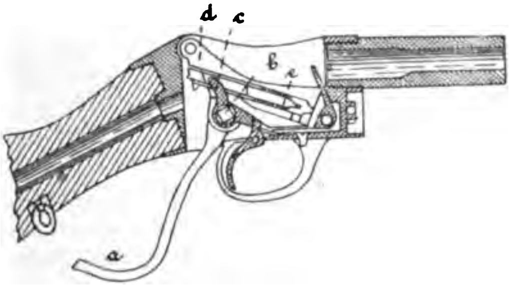
LEE-METFORD GUN.—*Kriegstech.* 3.




MAUSER RIFLE.—*Kriegstech.* 3.

The British army is armed principally with the Lee-Metford rifle 89 M II, but in 1895 the old Henry-Martini guns were altered at Enfield and furnished with a bore of the same dimensions as the Lee-Metford, and firing the same projectile. These guns were issued to the volunteers at that time, and it is probable that some of them are now in use in South Africa.

The Boer army has mostly the Mauser gun: the Transvaal Boers the model 93/95, the Orange Boers the latest model (98); but the latter also use in part the old 0.45-inch Henry-Martini, a number of which they purchased from England in 1894.




HENRY MARTINI.—*Kriegstech.* 3.

*Results of Firing of Mauser Rifle.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Height of trajectory at | | | 500 m. | | 3 feet | 5 inches. |
| " | " | | 550 m. | | 4 feet | 3 inches. |
| " | " | | 600 m. | | 5 feet | 4 inches. |
| Deviation | (mean) | at | 200 m. | vertical | · | 6 inches. |
| " | " | " | | horizontal.. | | 5 inches. |
| " | " | | 1200 | vertical...... | 4 feet | 5½ inches. |
| " | " | " | | horizontal.. | 3 feet | ½ inch. |
| " | " | | 1500 | vertical...... | 10 feet | 11 inches. |
| " | " | " | | horizontal.. | 5 feet | 10 inches. |
| " | " | | 2000 | vertical.. ... | 20 feet | 7 inches. |
| " | " | " | | horizontal.. | 5 feet. | |

Space completely swept for infantry, 1969 feet.
" " " " cavalry, 2297 feet.

Captain JOHN P. WISSER, 7th Artillery.

[To be continued.]

# THE MODERN INFANTRY ATTACK AND THE ARTILLERY OF THE DEFENSE.

[Translated from the *Jahrbücher für die deutsche Armee und Marine.*]

Our Drill Regulations for the Infantry are based essentially upon the experiences of the War of 1870–71. Hence there is to be found among these regulations certain rules which are no longer applicable in view of the improvement in modern ordnance; and especially is this true in regard to the most important part of the infantry tactics, the attack in the open.

This remark is pertinent as regards the conduct of the infantry when opposed to the artillery of the defense. In our last war the German infantry had hardly to reckon at all with the artillery of the defense. When the German infantry began their attack, the French artillery had usually been entirely silenced by the superior artillery of the Germans, and thus there remained only the infantry of the defense to deal with. This condition is exceptional in the history of war, and will not probably recur, since nearly all the great powers have their artillery in a like high condition of efficiency.

The infantry of the attack, in spite of the earnest support of their artillery will in general have to cope with the artillery as well with the infantry of the defense. The opinion that after a few hours artillery duel the artillery of the defense will be completely silenced, is a pleasant dream that will hardly be realized in actual war. Who can tell whether the defense has not kept in reserve entire batteries which will now be brought up intact? And how great would be the execution accomplished by even scanty artillery in good condition, when the infantry attack comes to close quarters!

And it must be remembered in this connection that it is hardly possible to silence the howitzer and mortar batteries now so generally introduced, for they are nearly entirely covered, and up to the last they will be able to bring their high-angled fire against the infantry of the attack.

And even had the regulations kept better pace with the shrapnel fire of the past, changes would still be required to meet the improvements that are now making in this projectile. The trajectory is flatter, the bullets have more penetrating power, the thickness of distribution per square meter has increased, the

rate of fire has risen from 2 and 3 to 6 and 8 aimed shots per minute, and moreover the organization has improved and the number of guns increased.

Now the experience of war (at least under European conditions) is lacking to point out in what manner the infantry shall carry out their attack in the presence of such artillery power. Peace maneuvers teach little concerning the effect of projectiles, and may even be misleading. There remains then but the third factor upon which regulations are usually founded, actual shooting upon the proving ground, and hand in hand with this the teachings of ballistics. Both practice and theory show unmistakably what targets are most vulnerable to artillery and hence what forms of attack are most dangerous for infantry.

Let us examine what targets are most exposed to artillery. First of all, such as make accurate range-finding easy ; hence those in firing against which the smoke-cloud that arises from the bursting percusion shell used in range-finding would stand out distinctly, since this permits a correct judgment as to whether the shot went over or fell short.

For this reason, all broad, compact, "wall-like" targets should be avoided, especially long deep masses of skirmishers, though such are permissible at short distances when augmentation of one's own fire requires it.

Instead of these, to minimize the effect of the enemy's artillery fire, are to be recommended : (a), numerous sub-divisions in column with narrow front and intervals between the columns ; (b), thin, open, and not too long line formations.

The finding of the range by the artillery firing against the first kind of target is made difficult by the following circumstances: (1), errors can easily arise through a misapprehension of the target in the distribution of the fire ; (2), many shots will be lost in the intervals between the columns ; (3), on account of the narrowness of the target it will not be easy to compare the position of the smoke-cloud with it.

Later in the attack the effectiveness of the artillery fire of the defense will be reduced by the fact, that even though the shots are well aimed and the distance of the point of bursting from the target is small, yet only a small part of the bullets of the shrapnel can hit the target ; moreover, the artillery will not be able, as when firing against long deep lines, to change the aim from one target to another without losing time in determining a new range. Similar difficulties present themselves in firing against open line formations.

Deep lines present the easiest kind of target for shrapnel, partly on account of the flatness of the trajectory of the sheaf. Whether the projectiles burst immediately in front of the line or 200 meters in front will make little difference, for the effect will be considerable in either case; and the errors of the cannoneers in the excitement of battle will not make much difference on account of the simplicity of laying the gun against such easy targets.

With the old shell of 1870 the case, to be sure, stood differently. These had to be well placed, and then their effect extended only a few paces beyond the point of fall, and still less laterally. The shell of that time were much less effective against skirmishers than against colums, especially against columns with broad fronts. At that period therefore the distances between the successive echelons in battle could be smaller by a half than after shrapnel had been introduced; and so little was the penetrating power of the bullets and fragments that formations two or three deep could be marched up to the closest ranges.

The older drill regulations based on the experiences of the French wars have become still more out of date by the introduction of an improved shrapnel.

General Rohne has shown very convincingly the disadvantages of a closed firing line, basing his conclusions on the probability of hitting such a target as compared with thin lines with adequate reserves. Hence early deployment of entire companies, as in France and Russia, while probably sound from a tactical point of view, is hardly to be recommended on account of the increase of losses. This disadvantage is counterbalanced by the fact that the front occupied by the company when deployed is decidedly broader with France and Russia than with us and Austria; in France and Russia it is respectively 150 and 200 m., with us and Austria it is 100 m.

Let us now see how the modern infantry attack is outlined by the new regulations (the French dates from 1894, the Russian from 1897), in so far as the form of the attack is made to meet the increased power of the modern arms.

The French regulations are essentially as follows: The first line moves forward in double column with intervals, corresponding to the indicated front. Later the companies separate, each led by its proper commander, and then the companies divide into platoons and sections, which go forward in double rank, opening up to one or more paces between files when in the zone of the enemy's fire or deploying into lines of a single rank.

The entire march forward is secured and veiled by an advanced line of scouts (32 to a company), who disturb the enemy's artillery and develop the positions he occupies. The reserves of the attack follow at from 400 to 600 m., at first in double column with intervals, later taking the most suitable column of march. The immediate reserves of the firing line are at first not closer than 300 m.

Ideas similar to those are found in the Russian regulations, which are based partly on the French. On account of the great range of the modern artillery (the sight of the German field gun is graduated up to 5000 m.), the formation for attack will be taken at not less than 4200 m. from the enemy.

Protected by the advance guard and a line of scouts, the main force moves forward in marching formation, until near the enemy's fire zone. Then the foremost companies form line of sections without opening files, or they deploy into line preserving intervals between the sections.

The reserves move forward in line of sections when under the enemy's artillery fire, and preserve this formation when exposed to long range infantry fire, or the files may open out; when under a severe fire they proceed in open order, the sections abreast, or better still arranged in checker-board fashion.

It is expressly set down that the fighting line before the decisive movement should be reinforced until it is two or three men deep.

We thus see that the new regulations are taking into account the teaching of the proving ground and of ballistics that we spoke of above. The attack is to be made at first in numerous, open, narrow, columns; later, when near the enemy in a line formation, open and in single rank, crowding together being avoided; this line forms the firing line at a comparitively late period in the attack.

The Russian regulations as compared with the French prefer a line of columns to a double rank formation, and enter into numerous details in connection with the artillery fire and the different zones of small-arm fire, and prescribe precisely the distances to be taken by the reserves, and even go into details about adapting the movement of the attack to the nature of the ground.

It is not to be denied that many of these provisions are traceable to the old national force-tactics, and are not entirely made in view of the power of modern weapons. It is also true that the Russian method, from our point of view, leaves too

much out of sight the object of the attack, to attain finally a superiority of fire; it also enters too much into detail; but the earnest endeavors to reduce losses, and the dispositions to this end, are worthy of study, and show that in this matter we are backward. The movement forward in numerous narrow columns and in thin lines, as well as holding the reserves further back, are points that cannot in the future be neglected.

In contradistinction to the foregoing dispositions the German regulations prescribe a heavy firing line as the most important and most generally suitable form of attack, while these recent foreign regulations consider a heavy firing line as necessary and indispensable only at close range, when the attack must bring to bear an intense fire.

Many other German regulations are no longer sound; for example "the line formation is recommended for the reserves when in view of the enemy,"—this is not generally good practice, and is correct only at close distances.

All regulations consider the column as a formation more easily hidden by the terrain, and this gives additional value to the new regulations which prescribe numerous narrow columns.

Above all, the latest regulations are very much concerned with artillery, the French battalion commander is particularly directed to engage with the enemy's artillery; the artillery of the defense is recommended as the first object for the attack to fire at; the advance scouts are to give especial attention to discovering the position of the artillery of the defense, and the first line of the attack is to preserve its own artillery and attack the artillery of the defense.

The French scouts (and to a certain extent the corresponding body with the Russians) in connection with their task of breaking up the artillery fire of the enemy, have the advantage that their very open formation scatters the enemy's artillery fire and distracts it from the main forces. Whatever forms our infantry attack may assume in the future, and however far it may separate from tradition this is certain, that the merciless fire of modern arms is an unchanging factor, and the best infantry will have to reckon with it.

If the infantry attack hold it essential to its success that it should attain a superiority of fire, then must it make such dispositions that the forces it puts in will come up to the enemy in a condition to fight. Rl.

[Translated by Geo. Blakely, 1st Lieutenant, 2nd Artillery.]

# THE 5-INCH B. L. HOWITZER.

## TECHNICAL CONSIDERATIONS AND FIRE TACTICS IN THE FIELD.

BY MAJOR H. P. HICKMAN, R. A.
*Secretary to the Ordnance Committee.*

[These papers were written for the use of Lieut.-Colonel Waldron's Howitzer Brigade Division on the eve of their departure for active service in South Africa in January, 1900.]

Reprinted from *Proceedings of the Royal Artillery Institution.*

At the request of Lieut.-Colonel Waldron, I have prepared this paper for the consideration of the officers of his Brigade Division. Owing to the short time at my disposal it does not profess to be more than a mere sketch of a big subject, in fact, little more than a basis for discussion.

In the views I have expressed it has been necessary to be guided by the very small amount of training that officers and men will have had, and also the possibility of the batteries being called upon to undertake tasks that have not been hitherto considered as coming within the rôle of howitzers.

The most important question to decide is whether the battery shall come into action in the open, where direct laying can be employed, or behind cover.

Some of the considerations in favor of the former are:

1. Simplicity due to direct laying over the sights and avoidance of the complications (to insufficiently trained men) of getting the line, picking up auxiliary marks, etc.
2. Better line for the first ranging rounds, and consequent saving in ammunition.
3. The Battery Commander can do his own observation.
4. Ease with which the fire can be turned on to different objectives.

The fourth of these is, perhaps, the most important, and where an extended position has to be shelled over a considerable part of its length, the exposed position appears to be essential; further, in the preliminary bombardment the exact location of the trenches of the enemy may not be ascertained, in fact are not likely to be until our infantry attack is well developed, and any delay in directing the fire on the enemy at that period would be

fatal, and if the critical moment when the enemy first opens fire is not promptly seized the advance of our infantry may mask any subsequent fire.

The advantages of a position under cover are:

1. Immunity from the enemy's fire and consequent freedom from casualties, and it follows that there would be more probability of accurate fire owing to freedom from flurry and excitement.
2. Advantage gained by taking the enemy by surprise when fire is opened.
3. Possible moral effect on enemy due to shells arriving from an unknown quarter.
4. Limbers and wagons can be close to the howitzers so saving labor in shell supply.

In balancing the above, the importance to be attached to the enemy's Artillery fire must be a factor, but unless its effect is more serious than has hitherto been the case this factor may perhaps be disregarded, and in view of my previous remarks as to difficulties for the inexperienced in carrying on fire from behind cover, and the solid advantages of the exposed position, I advocate the latter.

When more experience has been gained and training has been perfected, and when you are not required to do more than shell a comparatively small object such as a field redoubt or fortified post and there are strong reasons for being under cover, then, no doubt, you will more frequently make use of it.

With regard to the actual ground to be selected, ground which slopes slightly to the front is to be preferred as saving much labor in running up, ground sloping to the rear being particularly objectionable; the forward slope is preferable to the crest line as regards comparative invisibility, but it must be remembered that if the slope is considerable a change of objective means a considerable change in difference of level of wheels and the necessity, with each change, for ascertaining this afresh. Bearing this in mind you will probably elect to take a level site for choice.

If Artillery fire is anticipated it will be necessary to consider the question of cover for the limber (or wagon) but I consider there is little risk except from a heavy shell striking direct; even then the shell struck would probably not detonate and its explosion would not necessarily explode the other shells, in fact lyddite shells have been broken by a shot striking them without bursting at all, whereas a powder filled shell would be almost sure, when

struck, to set off all the other shells in the limber. It seems probable that small shells (12-pr. and below) would not explode 5-inch lyddite shells at any ordinary range.

The conclusion would seem to be, that, if there is no cover available, it is a fair war risk, and against small shells a slight risk, if any; but that in taking up a position for the guns it is just as well to try and obtain protection for limbers and wagons if the efficiency of shell supply is not seriously interfered with. It should however be borne in mind that the rate of fire will never be very great. The *probability* of a direct hit by a heavy shell is another matter, it is of course extremely small.

Without having more information than can be gleaned from the newspaper correspondents, one would gather that the first objective for howitzers to be considered is the shelter trench.

These are apparently of considerable depth and to render them untenable would require accurate fire and a steep angle of descent for the shells. The chief difficulty will be to detect them and this will probably be an impossibility until the defenders actually open fire; they may be situated near the tops of the kopjes, some way down the slope, or at the foot, and possibly might not be occupied at all in the early stages of the attack; in this case the defenders might be on the reverse side of the crest and in any case there would probably be reserves there. Under these circumstances it appears to me that the proper thing to do (failing an indication of the trench itself) is to range on the general crest line and to get the first round +.

Against such an objective, observation by the Battery Commander is all that is required or indeed possible. When the short bracket is found not another round should be fired on that line, for, where once a shell has fallen, any defenders near will move off. The line should accordingly be shifted 100 or 200 yards further along; whether any alteration is given for the first round at the new spot chosen to range on will be easily judged from the general trend of the crest line; a long bracket will hardly be necessary again but the short bracket should be again obtained, and probably something like one round — and two + would be quite sufficient before again moving on to a fresh spot. In this manner the top of the position as far along as is desired may be effectively worked, but the Battery Commander should note down the correct elevation for each part that he has ranged on, and when the infantry advance forces the defenders to open fire and disclose the actual position of their line of entrenchment, it should be possible to give such an alteration in the elevation

previously found as would bring the trajectory on to the desired level on the hill side.

In this attack it will be noted that the line is of secondary importance and observation not difficult.

Not only against the shelter trench but, I may add, against every objective I consider that the shells should have the greatest angle of descent possible if the full value of howitzer fire is to be obtained; for even in the above general bombardment of a hill, a shell that apparently goes wildly over the crest may, if it drops sharply on the further slope, find its billet in a mass of the defenders or reserves. Therefore, given reliable range-finding, if I were asked to state some general rule, I should say—

| | | | | |
|---|---|---|---|---|
| For ranges up to | 2000 | yards | use core and | 1 ring. |
| " | 3000 | " | " | 2 rings. |
| " | over 3000 | " | " | 3 " |

By adopting this there will always be about 600 yards to spare, for a glance at the range table will show that if you use the core and 2 ring charge at say 3500 yards, and it became necessary to increase to 3700, you would be out of the range table and have to change the charge to full and commence ranging again. Also, if you used the full charge at 3000 yards the shell would have only about 20° angle of descent, whereas the core and 2 ring would have nearer 45 and therefore give far more searching effect.

The remaining velocities are in all cases low and not worth considering one way or the other.

The accuracy with all the charges is very good, and although the corrections for wheels, drift and wind are all greater for the lower charges that is hardly worth considering.

Howitzer fire may be demanded against a gun well sheltered and possibly provided with splinter-proof protection against shrapnel bullets. Field guns are useless against this and the gunner's aim should be, not to knock down a parapet, but to hit what is behind it; therefore here again high angle fire is to be desired.

Accuracy in *line* is all important. A flank observing party will here be of the greatest assistance, even if only sent a few hundred yards off; I believe there is nothing better than the old method of observation, viz.:—The observer notes whether the shell bursts right or left of *his* line of sight to the enemy's gun, if the former he holds out his right arm (his *back* being to the Battery) and if the latter his left, if in line he might hold his

hand above his head. The Battery Commander must then compare his observation for line with that of the observer thus:

Right from Battery left from observer must be short.

Left " " right " " over.

Right " " right " may be slightly short, range, or slightly over, and the same if left from both.

Thus there can be no certainty unless "line" is observed either from Batte.y or observer.

With a badly defined objective a couple of aiming posts planted in line with it will much assist observation. It will be observed that no attempt is made to estimate the amount short or over.

For this ranging at a single gun I strongly recommend getting the range with *one* howitzer only as saving ammunition, for if all were used the line for the first round from each would probably be bad, leading to many of the first rounds being doubtful, for until a round from the Battery is "line" there is no certainty as to whether it is + or −, and there would be a considerable expenditure of ammunition before the short bracket was obtained with certainty. Owing to the long time of flight there would be no loss of time in ranging with only one howitzer and it is much simpler for the Battery Commander in every way.

When the range is found it will be a question whether the other 5 howitzers shall join in. I should say *not*; because 5 rounds *at least* a·e at once thrown away, for each will surely require a correction for line causing some loss of time, and there is no advantage gained that I can see.

If there are several guns in Battery, the last paragraph does not apply, and there seems no reason why all the howitzers should not join in with the first one as soon as the short bracket has been obtained.

The present pattern of foresight is considered strong enough not to require removal before firing and the bar being serrated, the sliding leaf should not shift; at the same time the latter should be looked to to see that it does not become unclamped.

I recommend removal of the tangent sight, as the sliding leaf is more liable to shift than with the foresight, and it will probably be convenient to keep it clamped at a fair elevation in laying for line.

The Officer Commanding should satisfy himself at once that his clinometers are all in adjustment, they are often a little out and any difference in this respect throws out the ranging.

For ascertaining difference of level of wheels the clinometer placed at right angles across the clinometer plane gives practi-

cally correct results, but the howitzer should be about horizontal to get accuracy.

Where there is difficulty in pointing out the objective to layers the following plans might be worth consideration:

1. If a well defined object exists in the immediate neighborhood of the objective, or even much short of it but more or less in line, this might be taken as a laying point, the Battery Commander estimating the necessary deflection to strike the objective.

2. If there is no such object available as in (1), the section officer places himself some yards in rear of the howitzer and directs a number to plant an aiming post (as far to the front as convenient) in line between top of foresight (set at 3) and the objective; the howitzer is then laid for line on the aiming post, and I then recommend picking up an auxiliary mark as far to the front as possible. I much prefer this to continuing to lay on the aiming post as the latter course necessitates great care in running up to the same spot each round and can never lead to that accuracy in line, which, as I have before pointed out, is so essential when firing at a small objective such as a gun.

It would save much time and trouble if one howitzer only were laid in the above fire; ranging could then be proceeded with with this, and as soon as the shell are seen to be dropping correctly for line the layers of the remaining howitzers can lay on the burst of the shells, and then each pick up his auxiliary mark ready to join in in the fire when ranging is completed. There would be saving of ammunition, saving of time, and greater accuracy of fire; it will have been noticed that in all the suggestions I have made I have been largely influenced by the necessity for economy in expenditure of ammunition; if the supply of this were unlimited one would probably advocate quite a different procedure.

A few rounds skilfully placed are worth any amount of wild firing. For a small and ill-defined objective, deliberate fire with every round carefully accounted for is essential to success.

I recommend that it be a standing order that, *before leaving the gun park* or at all events before coming into action, it shall be the duty of No. 4 to see that his deflection bar is at zero and his sliding leaves firmly clamped at 3. I have seen a layer go beautifully through most complicated evolutions in getting his line and auxiliary mark only to find he had his sliding leaves and deflection at the previous day's settings.

It should not be left till coming into action: you may be bustled and you may be under fire.

If the ground is very uneven it is well worth getting a spade and levelling a bit where the wheels will rest, removing loose stones, etc.; if the wheels are much out not only is the correction for them considerable but the clinometer gives unreliable results in elevation.

The elevating gear has a jamming handle for clamping when elevation has been given; it will be found very useful as the elevation used to alter on pulling the lanyard.

Deflection for difference of level of wheels is of great importance, and the section officers must watch this; it is worth making the gun layer select his ground so as to try and have his wheels fairly level, and at least to avoid sandy and stony ground if he can get a fair bit of turf handy; the worst thing is to have one wheel on sound and the other on soft ground as the latter will sink every round entailing constant correction and strong language from the Battery Commander.

The Battery Commander should make a liberal estimate for *wind* in the first instance; these shells are very long and much affected, and it is better to err on the side of getting the shell too far to windward of the object than have it go to leeward. The smoke from a lyddite shell when it detonates correctly is rather thin and unless the burst is in suitable soil, there may not be much to show..

The new fuze is very safe against prematures, as safe as a fuze can be, but it is a new fuze and has a heavy pellet and I do not recommend carrying shells fuzed in the limber; there is no necessity for it as the fuzing and supply of shells can easily keep pace with service of the howitzer.

It may be necessary to resort to laying from behind cover; the handbook gives all that is required, but as soon as the line is taken up, I strongly recommend an auxiliary mark *in rear* being picked up. It should be *as far off as possible* provided it be a clearly defined object, as this does away with all necessity for accuracy in running up to the same place each round—a consideration in view of the way the ground, if at all soft, gets dug up by the recoil. But I strongly recommend this being carefully attended to or the difference in level of wheels will be constantly altering—a great nuisance.

Care is necessary not to get too close behind steep ground in front for fear the trajectory may not clear it; indeed such a position would be most inadvisable for many reasons.

This fire requires very careful training and a reliable observer, with good organization as to signals.

I fear a great deal is expected from lyddite. The 5-inch shell has a fine burster but the walls are very thin, and the better the detonation the more local is the effect, as the fragments are then very small. It cannot be regarded as a man-killing projectile unless it falls in a crowd, and against a shelter trench it must burst on the crest or right in it to do any damage, this entails great accuracy of fire. Of course if a shell burst in the right place though it may not kill many in a thin line of defense it will shift those in the immediate neighborhood. Against a gun a direct hit is essential, for, unless the burst is close enough to blow a wheel to pieces, the fragments are very unlikely to injure any other part of the gun: the larger fragments of a common shell might do just as much damage. Against a field redoubt, buildings, splinter proofs, etc., it is at its best, as these cannot be rendered untenable by shrapnel fire.

When infantry is attacking any position which is being bombarded it will be a fine point to know when the howitzer should cease firing. I rather think someone belonging to the Battery should advance with the infantry, or to a suitable position, and be responsible for giving the signal. No doubt by this time they have some experiences of the best thing to be done, but from the accounts I have seen, in a least one case the Artillery ceased too soon, while in another guns went on to the danger of our men. Against a commanding position, the Battery Commander of a howitzer Battery should be able to see the infantry commencing the ascent, but I doubt the infantry Commanding Officer giving the word to charge when our shells were bursting not very far ahead of him unless he knew they would cease in time. If they are accustomed to keep a pretty long way off until the field guns stop firing they may think it right to do the same with howitzers and it will have to be made clear that there is a considerable difference and a proper understanding arrived at by both parties.

It is hardly necessary to point out that the advantages in observation of fire obtained by sending an officer forward, whenever practicable, are not easily over-estimated; for communicating results ordinary flag signalling is by far the most reliable, but if signallers are not available the code to be agreed on must be made a matter of drill, for mistakes might lead to serious consequences.

## NOTE.

BY MAJOR E. H. PATERSON, R. F. A.
*Instructor in Gunnery at Shoeburyness and Okehampton.*

A Battery of 5-inch howitzers was sent to Okehampton in 1897 for the purpose of comparing its mobility and efficiency, and effect with that of a service 15-pr. battery.

As was to be expected it proved very inferior in mobility; and there is no doubt that a battery of these howitzers cannot hope to compete with a field battery in moving over any ground except smooth hard roads—and there is no use in its trying to do so. It can trot along a good road, or over smooth hard grass, or sand; but in anything like heavy ground detachments must be dismounted, and the pace must be a walk.

As far as efficiency is concerned, the howitzer was found to be a very accurate shooting gun at all ranges between its extreme limits; but it is not advisable to use the core only, nor to fire beyond 4,500 yards for great accuracy.

As to effect, on this occasion—1897—*shrapnel* was fired against ordinary Field Artillery targets, and the increase of effect obtained by the 50-pr. shell was not sufficient to justify the adoption of shrapnel for this purpose; the field guns could attack these targets with shrapnel far more quickly, (and) with equal effect in the same time, and it was then decided that the projectile for the field howitzer should be Common shell alone,—and that the howitzer should be reserved for the attack of targets which could not be successfully attacked by field guns.

In this connection it may be mentioned that shrapnel fired with a high angle of descent can reach targets which are secure from the trajectory of the gun; and shrapnel form part of the equipment of most, if not all, foreign field howitzer equipments. But it must be remembered that the remaining velocity of a shell fired with a reduced charge, at a high angle, is comparatively small, and the velocity of the bullets when released may not be sufficient to produce effective results.

Then, in 1898, two howitzer batteries practiced at Okehampton with common shell only; and one battery went to the Soudan with high explosive shell; this battery also took some case shot; and Colonel Elmslie has fully related his experiences at Omdurman, and we know how the howitzers were employed there, and how they behaved.

The batteries which practiced at Okehampton carried out a different programme from the Field Batteries. They were given schemes suitable to their special qualifications, such as searching

out ravines, dropping shell into a rectangle representing a brigade of infantry formed up in mass, distributing fire over the reverse slope of distant hills, etc. etc., and as a rule they were ordered to come into action behind cover.

The difficulty of observing the results of their fire against such targets was at once apparent, and the question of the use of observing parties, which were never made use of by the Horse and Field Batteries, was taken up, with the result that last year —1899—the 61st Battery had elaborated a very successful method of utilising a small party to observe results and communicate them to the battery. The details of this method are contained in an article by Major Hamilton Gordon, which has appeared in the *Proceedings of the R. A. Institution* for October, 1899.

Against targets in the open, such as those engaged by the 37th Battery in Egypt, observation is simple, and the procedure is similar to that of a Field Battery without the intricacy of ranging *for a time fuze.*

The targets given in 1899 were, on the whole, similar to those of 1898, but the batteries were asked to drop shells on both banks of a ravine running parallel to the front of the battery; and high explosive shell were used against one target in the open at a range of over 3000 yards.

With regard to this latter target the ground on which it was placed was soft, and the high explosive shell made a large crater, 10 or 12 feet in diameter and 5 or 6 deep, and dummies 20 yards off were not even blown down.

This would lead us to infer that hard ground and an enclosed space are the most suitable for these shells to fall on in order to develop the full power of a high explosive burster; for we have plenty of records of enormous effect obtained with these shell fired at Lydd.

These records can be found in the Text-book of Gunnery in the chapter on explosives.

As regards the question of whether the field howitzers should be brought into action to fire direct on their objective or to fire from behind cover, I imagine that that question will, as a rule, be decided for them by the nature of the ground at disposal, and the instructions issued by the commander of the force.

Howitzer Batteries should be prepared to come into action in both methods, without any difficulty; but it is advisable with their short gun to use the clinometer for elevation whether firing direct or from behind cover; and this secures uniformity of laying.

It must be remembered that when coming into action direct it is not only the enemy's gun fire that has to be reckoned with; we have had plenty of experience that modern rifle and small shell fire has become so deadly, that the exposure of teams and detachments is a more serious question than has hitherto been contemplated; and it is a question whether teams should not always be sent under cover when such is available.

By all means use auxiliary marks if such are available; but experience shows that a *distinctive* auxiliary mark is seldom easy to find, especially in rear of a battery where there is much movement of horses, wagons, etc.

Any really distinct mark either over the target on the skyline, or directly between the battery and the target is invaluable—especially if distant—as it does away with the necessity of running up to the same spot each round. A mark that requires the use of the sliding leaves is a complication for field pieces, and it may interfere with the corrections for deflection. As a rule, I imagine, the aiming posts will be found the most convenient for marking the line, and they are always at hand. Wheel markers are a useful store, not provided in the equipment, but carried and used by several batteries.

I entirely indorse Major Hickman's remark as to the importance of having the wheels as level as possible; the drift and deflection of this projectile are hard enough to legislate for under ordinary circumstances, without the complication of arranging for the difference of level of wheels—a correction, by the way, which is frequently neglected in the flurry of coming into action, and obtaining the correct line of fire. It should be remembered that the higher the trajectory, with a reduced charge, the longer time have the forces causing drift and deflection to act; and with a varying wind it is hard to get uniformly accurate shooting with high angles of elevation.

Again, were Major Hickman's suggestion adopted of ranging with one gun and then bringing up the others, correction for line with these others would have to be made during battery fire, when the Battery Commander might have difficulty in knowing which gun to order it for after a particular round (it being presumed that section commanders cannot see the target); whereas were the guns all on the same level the deflection for the first gun should suffice for the rest,—provided that the aiming posts are accurately placed.

The method actually adopted by all the batteries during practice was that correction of deflection for each gun was made

during the deliberate process of ranging. Thus the order after a round was observed would be :— "Last gun 1 degree more right," and so on.

Another point frequently overlooked on coming into action was the question of whether the trajectory would clear the intervening obstacle. This is distinctly the duty of the section commander, and he should accustom himself to do it whenever there is an intervening obstacle. The method is clearly laid down in Field Artillery Drill, page 95.

As long as they are not exposed to the enemy's fire it is advisable to have the full detachments of nine men close up to the guns. Nos. 8 and 9 should be marched up from the wagon line in proper formation under charge of the senior, and utilized to assist in running the gun up into its position after firing.

High Explosive shells are always painted yellow, and require no special precautions in handling, or loading. But, as Major Hickman recommends, they should not be carried fuzed in the limbers or wagons.

The fuze has a cap which must be removed before loading, and if there is a pin it must also be extracted. Blinds occurred at Okehampton last year owing to the fact that the loading number did not withdraw the pin—perhaps regarding it as a time pin.

It is satisfactory to notice that High Explosive shells are if anything safer than Common powder shells, should a limber or wagon be struck.

The graze fuze is a new fuze and has not been used at a practice camp, so that no information can be given regarding its behavior (probably some experience has recently been gained at Lydd).

Sights should be used in laying for direction whether laying direct or from behind cover, deflection being given on the crossbar as required. In 1898 Tangent Sights were removed before the gun was fired; it was found that No. 4 had rather a handful with both his clinometer and his sight; and in 1899 Tangent Sights were left in the gun *always run down in the socket*, with satisfactory results. It is hard to put a fresh elevation on the clinometer when hampered with a Tangent Sight in the hand.

Clinometers are large and take some time to set, it may, therefore, be convenient to carry them set at about 15°. The bubble will not always stop accurately between the central marks, but the whole of the bubble should be seen in the glass of the level. The same rule as to depressing last should be observed when using clinometer, as when using the sights.

With reference to the proposal to range with one gun and take up the fire with the remainder, I believe it is recognized as a fact that a gun when hot ranges rather further than when cold; so that it is possible that the first few rounds from the remainder may fall short of the target—and it will be well to bear this fact in mind.

As to the question of arranging signals as to when howitzers should cease firing to allow of the infantry assaulting a position which is hidden from view of the B. C., it would seem that the only possible way would be for the order to be sent to the battery direct from the Officer Commanding the troops. This officer should be in a position from which he can watch the tactical development of the engagement, and he best can decide when the time has arrived when our shell fire is dangerous to our own troops. It is however seldom that a position to be assaulted would be hidden from the view of the Officer Commanding a battery.

# THE COLLIMATING CLINOMETER OF COLONEL GOULIER.

Translated from the *Revue du Génie Militaire.*

The depot of instruments of precision of the Geographical Service of the army has just finished, not without some difficulty, an instrument of Col. Goulier, which seems to be well adapted for use in preliminary surveys of roads in hilly countries, and in reconnaissances; we refer to the Collimating Clinometer (clisimètre à collimateur). The idea of this instrument is very old, mention of it having being made in *L'Aide-mémoire de Laisné,* (4th edition, 1861, p. 128), but the description there given by the author relates to a complicated instrument, somewhat resembling the Burel-Leblanc level, in which the mirror can be placed so as to make previously determined angles with the vertical.

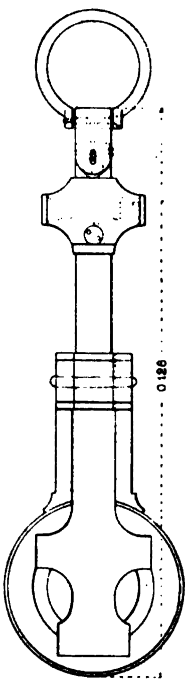



Fig. 1.

The collimating clinometer is a pocket instrument, analogous to the Lyre-level (Fig. 1) described in the *Mémorial* (No. 24, p. 239 to 241), in which "the compound collimator is replaced by a single piece of glass, terminated by two convex surfaces, one of which is at the focus of the other, as in the Stanhope lens."

The colonel had left an unpublished but more detailed description of it, only a fragment of which could be found, and this we reproduce verbatim; it is dated August, 1878.

"Some years ago we had succeeded in obtaining for the apparatus a collimator for slopes up to $\pm$ 0.15 or $\pm$ 0.20. It was formed of two distinct lenses and a micrometer traced or photographed upon a third glass. As it was extremely difficult to secure in a sufficiently firm manner the small pieces of glass which had to be used, and at the same time render their fastening hermetic, the fear always existed that dampness might produce moisture in the interior of the instrument—an accident that the operator could scarcely remedy.

"M. Tavernier-Gravet, the skilful constructor of instruments of

precision, thought to obviate this inconvenience by putting a sort of Stanhope lens in the place of the lenses above described. After some rather unsatisfactory trials independent of the Stanhope, and admitting the use of micrometers traced or photographed upon glass, the following result was attained, thanks to the manual skill and ingenuity of the constructor.

"The optical apparatus is a simple piece of glass 16 mm. long, about 8 mm. wide, and 3 mm. thick, terminated at the ends by two spherical convex polished surfaces, L and M, the second of which is at the principal focus of the first. Between these two surfaces an annular groove cut in the glass forms therein a circular neck 3 mm. in diameter, which produces the effect of a diaphragm (Fig. 2).

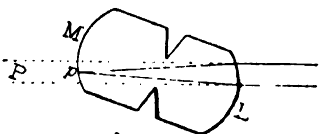


Fig. 2.

"From these arrangements it follows that the rays diverging from the point *p* of the surface M, and passing through, first the diaphragm and then the surface L, leave this surface parallel to each other, and that they affect the eye as if they came not from *p*, but from a virtual image F situated at infinity. Consequently the eye perceives a virtual image of the scale drawn upon M, which image is also placed at infinity.

"From this it follows that the displacements of the eye behind the diaphragm cause no apparent displacement of the divisions of the scale upon distant objects, because these displacements, whose amplitude can scarcely exceed in value the radius of the diaphragm, can not change in an appreciable manner the direction of the visual planes passing through the imaginary lines situated at infinity, that represent the virtual images of the divisions of the scale. *The oscillations of the head are, therefore, without influence upon the accuracy of the observations.*

"The scale just referred to, includes 71 divisions about $\frac{1}{10}$ of a millimeter apart, and numerous figures less than $\frac{2}{10}$ of a millimeter in height.

"If they had been engraved with a diamond they would have been too transparent. They were photographed upon the little spherical surface, M, 8 mm. high and 3 mm. wide, as above stated.

"Those who are conversant with photographic operations will doubtless ask how the difficulties of execution have been solved under such conditions, that is, the execution of a photograph *which for each instrument must have different dimensions,* since these dimensions depend upon the focal distance of the surface L, a

distance *that varies slightly* for each instrument. The explanation of it is given below.

"First, for the purpose of working the spherical surfaces and for the photography, two plates of glass were temporarily glued upon the Stanhope, which gave to the piece of glass the form of truncated octagonal pyramid. The optician determined by successive approximations that the surface M was at the focus of the surface L. He proved the coincidence by observing, through a magnifying glass adjusted upon infinity, and through the surface L, either the rough grains of the glass M before polishing, or the dust adhering to its surface after polishing. Then by tricks of the trade, the description of which would be too minute and too long, M. Tavernier succeeded in spreading the albumen regularly over the surface M, avoiding the production of noticeable seams on its edges. Finally he caused this surface to be placed in position to be photographed upon, using as the object glass of the camera, the convex surface L, and as object a plate of glass covered with black varnish and upon which the scale, very much enlarged, was represented by transparant divisions and figures. But between this sort of negative plate, placed but a few decimeters from the Stanhope, and the latter, there were interposed two convex lenses with long foci, which—the eye being assumed at the Stanhope—transformed the plate into a virtual image that appears to be at infinity, and whose divisions moreover subtend suitable angles.

"We must not neglect to state that in order to obtain this last result the divisions of the plate had to be made experimentally. The latter thus gave a suitable image, and one which could be phothographed upon the surface M.

"It is seen from these arrangements, considering the photography completed, that the pencils of luminous rays proceeding from the different divisions of the scale photographed upon the surface M, and traversing in an opposite direction the same path as those that have produced the photograph, are perceived by the eye to have the same inclination when referred to the zero division, that would be established by looking at the virtual image of the negative plate, that is, inclinations of 1 per 100, 2 per 100, etc. And let it be noted that this result is obtained without approximation, without hesitation of any kind, as soon as the glasses of the two convex lenses have been placed in the proper position with respect to the plate and the Stanhope."

The experiments of the colonel were interrupted by the death of the constructor, Tavernier-Gravet, who had not yet succeeded

in obtaining a satisfactory solution of the practical difficulties attending the execution of the photography of the scale, and the model exhibited in 1878 (Fig. 3) is the only specimen remaining, although as Col. de la Noë wrote of it in 1892, this was "the most convenient and the most exact of all portable clinometers, and that it ought to be issued generally and put into the hands of topographers."

This difficulty was so great in the first trials of the instrument that it caused Captain Talon of the Engineers, Commandant of the Topographical Brigade of Paris, to think of returning to the compound collimator. A level (arsenal model) mounted upon a stand, was furnished with a glass of this kind, and issued in 1897 to the School of Railroads. We do not know the results of the study then made of it.

Then, giving up the solution of the difficulty, Captain Talon substituted for the curved surface at the rear of the Stanhope, a plane surface (Fig. 4), modifying the model to be photographed in consequence thereof.

Fig. 3.

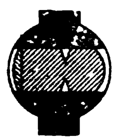


Fig. 4.

Another modification was made. The constructors regarded the model described in the *Mémorial* as too complicated. The expense of its manufacture did not permit it to be sold for less than the high priced Burnier compass. M. Henne, mechanic of the Central Depot of instruments of precision, and a student of Col. Goulier, was then shown how to devise another model of a still simpler form, which, be it understood, could be folded without leaving projecting surfaces, and was reduced to a very small volume (Fig. 5); it scarcely filled an ordinary vest-packet.

In order to take a sight, the eye must be so placed as to receive at the same time, the luminous rays proceeding from the object, and from the collimator. Figure 6 gives an idea of the sensation produced by the superposition of these two images on the retina.

The collimating clinometer was submitted to two trials during the campaign of 1898. The section of accurate surveys entrusted one of the pocket instruments to M. H. Vallot, one of the amateur operators of Mont Blanc; at the same time, one of the same type and one of the arsenal type were sent to the

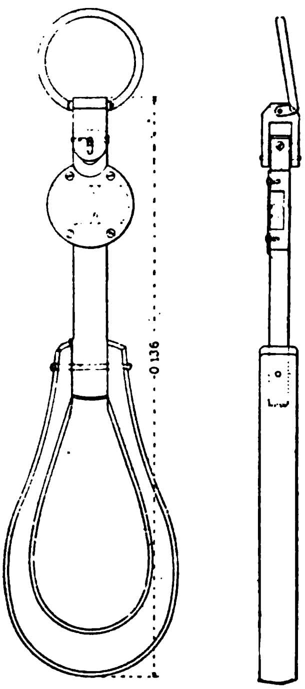


Fig. 5.

Chief of Engineers at Nice, who had them tried on difficult terrains for route sketching. The trial was conclusive. As will be seen by the reports hereto annexed, the pocket instrument gave the results expected of it.

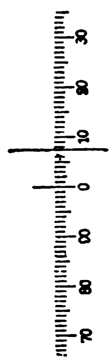


Fig. 6.

The present instrument is good for slopes up to 0.35, the practical limit of the field of use of the collimator. To satisfy a desire expressed by Capt. Dautheville at the end of his report, a suitable arrangement is being studied, by means of which the collimator may be stopped at two positions, at which the line o would be inclined above or below the horizontal at a convenient slope.

EXTRACT FROM THE REPORT OF CAPTAIN J. DAUTHEVILLE.

"A portable lyre clinometer was put on trial in the mountainous regions of the military district of Nice, during the campaign of 1898.

"This instrument was used by different operators in numerous operations on the terrain. Whoever the operator was (officer of Engineers or of Infantry), it gave good results as a reconnaissance instrument, and its direct and inverse readings were always verified to within about 1 per cent.

"As a first trial, it was given to an officer newly arrived in the locality, who used it to verify the slopes of a series of strategic routes forming a polygon whose perimeter was about 7 kilometers, with a difference between the extreme heights of about 200 meters. The distance between stations being reckoned upon the datum plane, the error in closing was 23 meters, say less than ½ per cent.

"After this first success, the instrument was made use of in open terrain, whose transverse slopes, always very steep, (they often reached 80 and 100 per 100), made the operations of setting up surveying and leveling instruments mounted on tripods, very

long and difficult. It was a question of laying out on this terrain, along the hill-side, but passing through certain required points, a wagon road admitting a limiting slope of 10 to 12 per 100 in profile, and about 7 kilometers in length. Employed at first to determine the secondary points of passage to be chosen on the sharp ridges separating the successive valleys, as well as to estimate the inclinations of the preliminary routes to be given to the operators in each section thus limited, the clinometer afterwards was used to stake out on the terrain a temporary line of road before being used as yet to determine precisely the working conditions of the surveying party. The survey with the plane-table and the leveling with the ordinary collimator level, which were afterwards made of this temporary line of road, gave results satisfactory enough to admit of its approval, and to admit it as a basis for the continuation of the staking out of the definite axis of the road to be constructed.

"This success induced another officer who had at first manifested a certain repugnance towards the instrument which he considered too mobile and too difficult to read, to apply for it for the preliminary survey that he was making of another line of road about 8 kilometers in length, but under very different conditions. He worked on a wooded terrain where the sights were necessarily short, and where, moreover, the nature of the soil made it difficult to get the rod-man into position. It was, in fact, a valley hill-side having quite a steep but irregular general slope composed of successive terraces of calcarous sandstone, each of whose benches formed a sort of wall, sometimes several meters in height, joined to the following wall by a slope of talus covered with thick vegetation. The line of road, which had to cross several of these steps, was, on account of the economy to be observed in its execution, to cut through them only at rare points, where the superior and inferior slopes of talus joined and covered the rocky bench for an extent often quite limited. The clinometer was very useful in looking for these crossing points, especially because it permitted the observer to eliminate positively, and without other aid, the points at which the temporary disappearance of the wall did not have a continuous length sufficiently great to be crossed at the limited slope allowed for the line of road.

"The portable clinometer was afterwards advantageously employed in laying out two mule-paths, allowing a slope of 15 and 17 per 100 in their longitudinal profile. One of them, given as a practice exercise by the commandant of a section to a lieu-

tenant of Alpine Chasseurs, was, thanks to this instrument, laid out on the terrian in a single morning.

"This problem was to reach, by a given and particularly abrupt declivity, the summit of a mountain 400 meters higher than the starting point. The solution consisted of the construction of two series of zigzags to be laid out on open ground, on two neighboring meadow lands with very steep transversal slope, and situated at different levels, on each side of a rocky foot-hill, which could be crossed with difficulty at a few points only.

"The undersigned captain of engineers, who had lent the instrument, and who afterwards went over the ground, felt satisfied that the point of passage on the foot hill had been suitably chosen, and that the line of road staked out was very satisfactory. It did not present sharp differences of slope and abrupt jumps, imperfections due to haste and lack of leveling instruments or operators, that too often characterize the lines of communication laid out by troops in mountainous regions.

"The other work, executed by a sufficiently numerous section of practised operators, consisted in locating and staking out on the terrain, a mule trail about 4 kilometers long, crossing two successive crests at required points. The reconnaissance of the terrain was made, and the staking out of the line was done by the portable clinometer. Even for running quite short zigzags, the head of an assistant was sighted upon instead of a stadia rod. The survey followed immediately ; it was made with the plane-table and the slopes were verified, both by the alidade and the collimating inclination level. The results were as satisfactory as in the preceding trials.

"A last trial, attempted by one of the operators who had assisted in this work, showed what limits ought to be assigned to the employment of this instrument. It was a question of verifying the location of paths and new lines of road laid out by the leveling alidade, in another region of the military district of Nice. In order not to be encumbered with personnel and materiel, the operator thought that he could effect his object by means of the portable clinometer, and he utilized it, not as before, to obtain sights accurate to within about 1/100 of the slope, but to obtain precise readings, allowing for the error between two consecutive divisions. The mobility of the apparatus rendered the work difficult and uncertain ; the conclusion was that it would be advisable to increase the weight of that part of the lyre-level used as a plumb-bob. But it is a question whether the hoped for result will be thereby obtained ; a precise reading

requires a certain period of time during which the collimator must be immovable; in this case, the necessity of having an instrument independent of the operator, and even an instrument mounted on a particularly stable base, has long been recognized.

"The authority of Colonel Goulier and his thorough discussion upon the comparative merits of stands with three, or with two feet (*Mémorial*, No. 24, p. 227, note) may be quoted in this connection. If the operator, then, will renounce the attempt to obtain with the portable clinometer a precision greater than the value of its divisions permits, the apparatus, so far as it has been tried, appears to satisfy fully the desired end.

"Upon the whole, the portable clinometer has rendered good service, and appears suitable to be put into common use as an instrument for reconnaisance work and for laying out muleteer roads.

"In closing, one cannot help expressing the desire that an instrument as practical as the portable clinometer, (which the extension alidade with the plane-table, 0.50 meters wide, is not, at least in mountainous regions) may be constructed to measure transverse slopes of 40 to 80 and even 100 per 100. It would be of very frequent use in mountainous countries, and especially in the Alps. Nice, November 18, 1898."

On Mount Blanc, M. H. Vallot employed the instrument in laying out a line of road; the following is his report of this trial:

"I had occasion when doing topographical work in the field in the vicinity of Mont Blanc, to stake out a short line of a mountain road. I employed the clinometer that you entrusted to me. For this purpose, it is a wonderful instrument. It was a question of running a line with a slope of 15 to 20 per 100 for a portion of a mule path to be rectified. I was accompanied by the tenant of the farm, who had originally laid out the path, and who undertook to carry and place the stakes according to my directions; and also by my customary guide, equipped with the stadia-rod—the red at the height of the eye. With the clinometer, the changes of position to be taken, in order to obtain the line considered the best, were made with remarkable rapidity and ease. I consider this little instrument admirably adapted to this work."

Moreover, M. Vallot has desired to show, by means of a series of readings made with the instrument and the leveling alidade, their degree of exactness, "the instrument being held in the hand, as under conditions of actual practice." He found

that the *errors* between the readings on the two instruments did not generally exceed 4/1000 of the slope, in slopes varying from 0.03 to 0.20.

We believe, then, that the problem that Colonel Goulier sought to work out, has been solved, and we hope, as stated in the beginning, that, thanks to the studies of Captain Talon, our comrades are going to find themselves in possession of an instrument that appears to be prepared to render real service.

E. CROUZET,

Lt.-Col. of Engrs., Chief of the section of accurate surveys.

While we were writing up this report, we learned that a little reconnaissance instrument called the *compass-level*, has been recently *patented*. This instrument is furnished with a collimating clinometer having a photographed scale. It is known that Col. Goulier never sought to obtain a patent for his inventions, but we are of the opinion that, as far as the collimating clinometer is concerned, the priority of his instrument can not be contested.—E. C.

[Translated by JOSEPH L. KNOWLTON, 1st Lieut., 2d Artillery.

# PROFESSIONAL NOTES.

## TACTICS.

### Method of Ranging a Group of Guns in a Coast Battery and Maintaining Accurate Fire without the Aid of a Position Finder or Depression Range Finder.

By Captain W. L. Warren, R. A.

[The possibility of using a gun and its sights as a kind of range finder is mentioned in *Proceedings R. A. I.*, Vol. XXV., No. 6, "Automatic Sighting," by Colonel H. S. S. Watkins, C. B., R. A., (see *Journal U. S. Artillery*, Vol. XII, p. 193). The necessity of having to fight heavy coast guns without the aid of P. F. or D. R. F. might quite likely arise in war time and as the drill book deals very briefly with such a case, the Committee publish Captain Warren's paper and hope that doing so may lead to further discussion on the subject. They would however observe that large practical errors might be introduced with low site batteries and a big tide, and that the difficult case mentioned at the end of his paper would seem an ideal chance for tangent elevation and no complications.—Secretary, R. A. I.]

In a Coast Battery, unprovided with a Position Finding installation, one of the most serious casualties in action, tending to check the rate of fire or to stop it altogether, would be, next to damage to a gun or its mounting, the destruction of a D. R. F. instrument. There are no spare instruments allowed in a work, and, even if there were, the delay in setting up another might be fatal.

The following plan has been tried both at drill and at practice at a towed Hong Kong target with aiming rifles fitted to the guns. With a little training, fire should be fairly rapid and quite accurate. It has been found that from *four* to *six* rounds can be fired from a group of two 10-inch B. L. guns on barbette mountings, while a D. R. F. instrument is being set up. The details were easily learned by all concerned.

The principle is this: Let the range of a target be known; lay the gun by Case II., at the same time setting the tangent sight to the correct range. The sights should then be found to be correctly laid on the water line of the target, and if the gun were fired, the projectile should hit the target at the water-line. Now raise the tangent sight "100 yards" without altering the quadrant elevation of the gun. It is obvious that the sight will be aimed at a spot on the water *short* of the target. Suppose the target to move to this spot, and the gun to be fired again, the projectile should of course fall at the same place as before, thus giving a "plus" round with the new position of the target, as the range has shortened and the quadrant elevation given to the gun has not been altered. From this it follows that if a "plus" or "minus" correction is required, the range put up on the tangent sight (when using this method) should be *more* or *less* (as the case may be) than that given to the gun by the yard scale plate (quadrant elevation).

**Drill.** *Battery Commander.*

"Range finder disabled." "Correction, plus 100 yards."
"Range Shortening."

*Gun Group Commander.*

"*A* 1." "2550 yards, correction + 100." "................minutes *R* (or *L*)."

"*Gun Captain.*"

"*A* 1." "2550 yards, correction + 100."

*Gun Layer.*

"2650 yards.................. .....................minutes *R* (or *L*)." "Depress." "On."

Gun Captain, (reporting to Gun Group Commander) "200 yards over."

On the range finder being disabled, the G. G. C. will estimate the range of the target, and when a gun is ready to fire, he will pass to the G. C. the range at which he estimates the target to be, allowing a good margin plus or minus according as the range is increasing or shortening. He will at the same time pass down the correction (for powder, tide, etc.) given by the B. C. (as above). The gun will be laid by Case II., the gun layer at the same time putting the range on the tangent scale, *plus or minus the correction given by the B. C. and passed by the G. G. C.*, together with the racer correction, if any. No corrections will be put on the index plate or yard scale plate.

The gun-layer will now keep his sights aligned on the bow of the target, and will give "elevate" or "depress" to the elevating numbers, so as to bring the sight on to the water line. The G. C. will then note the difference in yards as shown by the yard scale plate and report this to the G. G. C., as indicated above. The G. G. C. is guided by this as to the proper prediction to make, taking care that he gives a range *less* than that at which he estimates the target to be, if the range is shortening, and greater if the range is increasing, remembering that the "difference" reported as above by the G. C. is approximately only half the true difference which he must take into account, the sights having been altered in this preliminary trial.*

Final Lay.

The G. G. C. now gives his final prediction, (in all cases mentioning the correction), the gun is laid by Case II., the G. L. putting the range (plus or minus the correction) on the tangent sight, and keeping his sights aligned on the bow, waits till the water-line of the target coincides with the line of sight, when he fires the gun.

Thus, with range shortening, as before :

*Gun Group Commander.*

"*A* 1." "Lay, 2000 *yards*, Correction + 100 ............minutes *R*. (or *L*.)"
"Commence firing."

*Gun Captain.*

"*A* 1." "Lay, 2000 *yards*." "Correction + 100.

*Gun Layer.*

"2100 *yards*, .................minutes *R*. (or *L*.)"

*Gun Captain.*

"Fire *A* 1."

The G. G. C. gives "commence firing" as soon as the G. C. and G. L. have repeated the orders, as above.

It will be seen that the final lay is 550 yards less than the original range given by the G. G. C., *i. e.*, more than double the difference reported by the G. C., thus allowing for the range shortening, by ensuring that the prediction is short of the target.

* This can be proved practically or theoretically.

For the 1st round after D. R. F. is disabled, it should be possible to estimate the range with tolerable accuracy, for that last given by the D. R. F. would be a guide. The most difficult case is when the range is "constant" or nearly so, for, as the target will not *lay itself*, so to speak, the range for the final lay must be accurately estimated. No correction for displacement, but all other necessary corrections must be given.

—Reprinted from *Proceedings Royal Artillery Institution.*

### How is Fire Superiority to be Attained in the Infantry Attack?

BY LIEUT.-GENERAL VON ROHNE.

[From the *Militär-Wochenblatt*, Berlin, No. 71 of 1899.]

Translated by F. H. A. Bex, Librarian, Prince Consort's Library, Aldershot.

Although there still exsists a great divergence of opinion as to the method of carrying out the infantry attack, all are in perfect agreement on one point, viz., the necessity of fire superiority for success. Personally I would go so far as to maintain that victory is virtually in the grasp of him who commands fire superiority, and that the question of the infantry attack practically narrows itself down to the query, "How is fire superiority to be obtained?"

It admits of no doubt that, moral and material forces being equal, the attacker is placed in a position of far greater difficulty than the defender. The attacking line must necessarily, in order to reach its goal, momentarily suspend fire during the period of successive moves. Only in the most favorable moments of the fire period does it offer a target of only the size of that presented by the defense, but whilst in movement undoubtedly a much larger one. Skilful use of ground may affect this latter factor slightly, but not to any appreciable extent.

Odds being evenly balanced, theory must perforce award fire superiority to the defender, and is logically bound to attach certain conditions to the mere possibility of a successful attack. Such conditions are superior armament and musketry training, the co-operation of artillery and last, but not least, numerical superiority. It is not intended to maintain that the latter is absolutely indispensable to attach victory to the standards of the attacker, but in its absence one may only under quite exceptional circumstances reckon on unqualified success. To quote an example, such specially favorable conditions did prevail during the second half of the campaign of 1870-71, when the Germans were fighting against totally undisciplined and untrained men. For such fortunate contingencies, for which one is truly thankful and which are promptly exploited, guiding rules need not be formulated, but science must start from the standpoint of the duel between opponents of equal mettle.

During the 1866 campaign in Bohemia, the Prussian infantry gained many brilliant victories, even against a numerically stronger opponent, although its path to victory had not been prepared by the co-operation of artillery. Here superior armament was such an important factor that the infantry could afford to act without the assistance of artillery, and, relying on its own resources alone, was still certain of success. This advantage of superior armament consisted not so much in the faster rate of the Prussian infantry fire as in the facility for loading the needle-gun in any position—lying down, for instance—whilst the Austrian muzzle-loader could only be loaded standing; and a man in that position offered a target twice as large as that presented by a man lying down.*

* Compare Supplement 11, *Militär Wochenblatt* of 1898, "Measurements by means of photography of the vulnerable surface exposed by the skirmisher," p. 518.

In the Franco-German war the better weapon was in the hands of the French infantry, but the superiority—solely ballistic—was not nearly so significant as that of the needle-gun over the Austrian muzzle-loader, for to make matters equal the German artillery *matériel* was far superior to that of the French. The opposing batteries were, as a rule, driven from the field or silenced after a comparatively short engagement, when, unmolested by hostile fire, the German guns could be employed upon the task of preparing the point selected for the main attack. Wherever the German infantry knew how to wait for the effects of artillery fire, victory like a ripe fruit invariable dropped into their lap, in spite of the superior French rifle.

Since technical skill has been so successfully occupied in the improvement of weapons and the trade of the world has been opened to the sale of its products, the time when one could speculate on similar advantages of superior armament has passed irrevocably by. Hence science must take up the question of how infantry alone, unsupported by artillery, is to execute the attack, as artillery does not necessarily always form an adjunct to the smaller fighting bodies.

This leaves us only the consideration of superior musketry training and of overhelming numbers. Great improvements in shooting have been made in all Armies, but this by itself dwindles in importance when considered in full light. A unit may show excellent results in individual practices, but when less zeal has been applied to judging distance, its performances in the field will certainly fall below those of another unit whose merit in *both* branches is only moderate. Exampies without number prove this clearly in time of peace. Not once only, but repeatedly, have cavalry armed with the carbine—the inferior weapon—obtained a greater number of hits than well-trained infantry, distance and sighting being iden.ical. Both made the same error in judging their distance, which caused results to be lowered in both cases, considerably in the case of good shooting troops, and in a less degree in that of the more indifferent shots. I guard myself specially against underrating the value of musketry training. Thorough musketry training is above all a factor in the soldiers's education culcaluted to cultivate confidence in himself and in his weapon, and it imposes on him the conviction that good aiming and a steady pressure of the trigger alone suffice to ensure a hit. The fact of this not being true* matters little. A soldier so trained will never—at least, we fondly hope so—fire an entirely unaimed shot in battle.

Numerical superiority is still the main thing, quite as much as when, in the days of Napoleon, the God of Battles favored the big battalions. It rests with the higher leaders to take steps to enable this superiority to be brought to bear when the decisive day is at hand, whereas the responsibility for its correct employment rests on the shoulders of the tactician, and ballistics may also be permitted to utter a weighty word of advice in this connection.

I have demonstrated in earlier writings† that the percentage of losses suffered by a target of given breadth of front (the exposed individual surface being equal throughout) depends entirely upon the average number of hits per metre of front. Of two opposing lines of equa' length, one of which is double the strength of the other—rate of firing and ability to hit being, of course, supposed to be equal—the weaker one wi : suffer exactly the same proportion of loss, *i.e.*, double the percentage of the stronger, because double the number of cartridges have been fired against it. Hence it follows that,

* When judging distance practice has been neglected.—Translator.

† Rohne, "Musketry Instruction for the Infantry," Sec. 28.

other things being equal, the stronger side must undoubtedly establish superiority of fire,* and it is therefore in the interest of the defender when once he commences firing on the attacker to make his firing line at once as strong as circumstances will permit. He would otherwise be compelled to reinforce, to make good losses in the firing line, under the enemy's fire, and would thereby incur still greater loss, unless exceptional conditions of ground favored the advance of reinforcements completely under cover. He would also surrender the advantage enjoyed over the attacker of offering only low targets. Whenever the defender acts in the manner suggested, it will be impossible for the attacker to make his superior numbers tell in any frontal attack. Supposing he wished to cover his front more densely than the defender's—one man to each pace of front—the men would only interfere with each other with consequent additional losses (taken literally), without raising the effect of their own fire. The defender will sometimes find it feasible to establish several lines in terrace fashion one above the other, as, for instance, in the occupation of villages or of abruptly sloping heights, whereas the attacker never has a similar chance. Against a strongly occupied position liable only to frontal attack the attacker must surely bleed to death. Although his rearward lines may afford him the means of covering the losses of the firing line, it must be remembered that the defender also is not solely dependent on his single line of skirmishers, but that he likewise has reserves, perhaps not quite so numerous, at his disposal.

It is for this reason that the Drill Regulations for the Infrantry, Part II., Secs. 69 to 71, declare a purely frontal attack to be impracticable. By extending his front the attacker can certainly bring an increased number of rifles into action, but the defender may reply by employing similar tactics.

The only way in which it is possible to make numerical superiority really felt lies in the combination of the frontal with a flank, or enveloping attack. Both in 1866 and 1870–71 did the Prussian (respectively German) troops favor the enveloping attack, and employed it with generally good results. The principal advantages which make it, whenever successful, so effective are to be found in the fact of its threatening the enemy's line of retreat. I will not here dwell on this point, but will confine myself to the consideration of its bearing on fire effect, and shall endeavor to demonstrate that it is in fact the one safe way and means of arriving at fire superiority.

The enveloping attack facilitates the deployment of a firing line greatly exceeding the extent of that of the opponent, the attacking front increasing in width in comparison with that of the defense:

*a.* The smaller the angle formed by the flank attack with the original front,

*b.* the greater the distance from the enemy.

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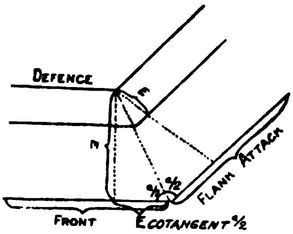
* The following may serve to make clear the extreme difficulty of counteracting numerical superiority by superior skill. Let us imagine a skirmishing line A composed of 100 rifles, whose ability to hit the target is double that of an opposing line B of 200 rifles, density of formation being equal. By doubled hitting power I mean that the individual shot in line A makes in a given time double the number of hits made by an individual in line B. Thus the proportion of hitting power would at the opening of the fight be as 1 : 1. Let us say that each line has eventually made 30 hits. Taking "Musketry Instruction for the Infantry" (appendix 14) for a basis, line A would have 26 men disabled as against 28 men in line B. But the loss of 26 men would be more acutely felt by A than the loss of 28 men by B, the former now disposing of only 74 rifles to the 172 of the latter. A having double the hitting power of B, the proportion, originally as 1 : 1, would now be as 148 : 172, or as 1 : 1·16. From this onward fire superiority will incline toward the stronger line in a rapidly increasing ratio.




If E (see diagram) denotes the distance from the enemy, *a* the angle of the flank attack with the proper front (respectively the angle of the enemy's newly formed flank with his original front), the measure by which the attacker's fire front exceeds that of the defender will equal 2 E cotangent *a*/2. If, for instance, *a* equals 90°, the attacker's front is prolonged beyond that of the defender:

| | | | | | |
|---|---|---|---|---|---|
| At the distance of | | 200 | metres by | 400 | metres |
| " | " | 500 | " | 1000 | " |
| " | " | 1000 | " | 2000 | " |
| " | " | 2000 | " | 4000 | " |

When, as in the diagram, the angle is one of 135° (the defender's flank in that case being thrown back at an angle of only 45°) the front of the attack will only be increased at:

| | | | |
|---|---|---|---|
| 200 | metres by | 208 | metres |
| 500 | " | 520 | " |
| 1000 | " | 1041 | " |
| 2000 | " | 2082 | " |

Directing the attack upon the enemy's salient point, the proportion of the attacker's to the defender's front will furnish a standard of the amount of fire superiority that may be expected to result. This proportion depends in a great measure on the breadth of front against which the main attack is to be launched. If it is intended, for instance, when the forces engaged are small, to force an entry into the hostile position over a space 100 metres wide, the length of fire front which can be directed upon the point will be at an angle of 90° (135) at the distance of:

| | | | | |
|---|---|---|---|---|
| 200 | metres | 100 + 400 = 500 | metres | (100 + 208 = 308 metres) |
| 500 | " | 100 + 1000 = 1100 | " | (100 + 520 = 620 " ) |
| 800 | " | 100 + 1600 = 1700 | " | (100 + 832 = 932 " ) |
| 1000 | " | 100 + 2000 = 2100 | " | (100 + 1041 = 1141 " ) |
| 2000 | " | 100 + 4000 = 4100 | " | (100 + 2082 = 2182 " ) |

Hence it follows that the length of the attacker's firing line, which at the distance of 200 metres is 5 (3) times that the defender, is at a distance of 2,000 metres 41 (22) times that length.

If, on the other hand, the point of entry is to be 1,000 metres wide, the attacker's length of fire front will be at the distance of:

| | | | | |
|---|---|---|---|---|
| 200 | metres | 1000 + 400 = 1400 | (resp. 1000 + 208 = 1208) | metres |
| 500 | " | 1000 + 1000 = 2000 | ( " 1000 + 520 = 1520) | " |
| 800 | " | 1000 + 1600 = 2600 | ( " 1000 + 832 = 1832) | " |
| 1000 | " | 1000 + 2000 = 3000 | ( " 1000 + 1041 = 2041) | " |
| 2000 | " | 1000 + 4000 = 5000 | ( " 1000 + 2082 = 3082) | " |

The odds in favor of the attack, which with the small front at the distance of 200 metres were as 5 (3) : 1, have dropped with the attack on the wider front to 1·4 (1·2); at a distance of 2,000 metres from 21 (22) to 5 (3).

It is remarkable how the length of the fire front—therewith fire superiority—increases with the distance from the enemy. This proves the high importance of artillery co-operation in an enveloping attack, because of the diminution of fire superiority at the very distances at which infantry fire assumes decisive effect (below 800 metres).

However, yet another factor appears which tends to promote fire superiority in an enveloping attack. In a frontal attack projectiles passing over the opponent's firing line only threaten danger to the supports in rear; but in the flanking attack a second target ofters itself to shots aimed too high. The attacker concentrates a vast number of bullets on a narrow space, whilst the defender, on the contrary, must distribute a smaller number over a wide range.

Should the attack succeed in making the effect of the enveloping movement surprisingly rapid, the chances of success are considerably improved; and if the defender is not timely in a position to form an angle with his second line, his front is exposed to a flanking fire, when to the already mentioned advantages must be added the further fact of individual firers in the lying-down position offering a much larger target to flanking than to frontal fire. The vulnerable surface of a marksman exposed to fire from a flank is, according to Supplement 11, *Militär Wochenblatt* of 1898, twice as great as that of a man being fired at from the front.

Another advantage accompanying the attack against a salient angle lies in the fact of the attacker's front constantly contracting with the progress of the attack, thereby reducing the necessity of reinforcing to replace the casualties which, in a frontal attack, is necessary in a much greater measure. And at the very moment of reinforcing the fighting line the casualties are most numerous, because a double target is presented to the enemy, one of them being a target of the full height of the body.

Two not unimportant lessons from the defense may be deduced from these studies. One is in the selection and occupation of positions to pay attention to strong flank defenses—strengthened if necessary by artificial means—in order to reduce the attacker's chances of success to a minimum. The other is to omit taking up points of support in advance of the main position, unless they are situated in such close proximity to the latter that in turning them the attacker must expose himself to a very heavy flanking fire from the main position.

I am avare that I have in these studies brought forward no single new point. But it appears to me to be important to show that tactical rules rest upon the laws of ballistics. I ask that the figures quoted may only be regarded as examples which can claim only relative, not absolute, significance.

—Reprinted from *Royal United Service Institution.*

## How a Field Gun of Greater Power might be used Equal to the 5-inch B. L. Howitzer in Mobility.

By Captain H. L. Powell, R. H. A.

Judging from our experiences during the present war, it seems extremely probable that a field gun of a heavier type than we possess would occasionally be very useful. Assuming that this heavy field-gun should be quite as mobile as the 5-inch B. L. Howitzer, I venture to make a few suggestions as to the way in which a gun of greater power might be employed in the field, say a 25-pr. with a range of 7000 yards, with little, if any, loss of mobility. The weight of a 5-inch howitzer and limber behind the team is about 46 cwt. Assuming that the number of rounds carried with the gun should be not less than 21, the number carried with the 5-inch howitzer, it is perfectly obvious that a somewhat lighter limber might be used to carry 21 shell of 25 lb. each, than the howitzer limber which carries 21, 25 lb. shell; the difference in

weight of the limber and ammunition, say between 5 cwt. and 6 cwt. altogether, could be utilized by increasing the weight of the gun and carriage by a similar amount without increasing the weight behind the horses. As most if not all Artillery officers are of opinion that a gun team should not consist of more than 6 horses, it is plain that we cannot further increase the weight behind the team without loss of mobility, unless we use more powerful horses. Would this be practicable? I venture to think that it would. There is a very powerful stamp of horse which would, I think, be suitable for the purpose. The horses I mean are those generally known as brewer's geldings; brewers I believe prefer geldings to mares. These horses are capable of drawing quite half as much again as our artillery horses. They can move at a steady trot, but of course could not gallop. They do not stand trotting on very hard roads like the London streets paved with cobbles or asphalt, as they get side bones from the concussion, but they would seldom, if ever, be required to maneuvre over ground of this description. The chief, in fact the only drawback to the employment of these horses is their cost. They could not be bought for less than £80 or £90 each. The cost, however, of horsing say 6 heavy batteries with horses of this sort would be trifling to a rich country like ours. There is no doubt that with these horses, the weight behind the team could be increased to 60 cwt. and a heavy and powerful field gun conld be used which would be quite as mobile as the 5-inch howitzer. Owing to the weight of the ammunition it would not be advisable to use a heavier howitzer than the 5-inch B. L., but the number of rounds carried with the 5-inch howitzer could be increased by using these horses. I do not wish to discuss the use of traction engines in place of horses for bringing heavy field guns into position as it is evident that traction engines could not be employed for this purpose without loss of mobility, besides there is the drawback of the large target they offer to the enemy, although at a range of 5000 yards it would not be very easy to hit even a traction engine moving 3 miles an hour. I can, however, see no reason why these engines should not be used for ammunition columns and heavy guns on the line of march, or for drawing siege guns into position.

—Reprinted from *Proceedings Royal Artillery Institution.*

## ARTILLERY MATERIAL.

### Gruson Chilled Cast Iron Turrets.

The Gruson chilled cast iron armor, which is used in many European countries for the shielding of heavy coast defense guns against fire from a hostile fleet, has heretofore been and is still manufactured only at the German works of Fred. Krupp at Grusonwerk. Operations are now under way, however, for the establishment of a plant at Eddystone, directly outside of Chester, Pa., where Gruson armor will be manufactured. This plant is being built by the Gruson Iron Works, which company, it will be recalled, were formed under a charter from the State of New York several months ago. This company have by agreement with the German firm acquired the exclusive right to manufacture turrets and chilled armor plates for coast defense, and to use their processes, experience and information for the purpose of producing similar material for this country. The new works will in this wise introduce a new industry into this country and put within reach of our Government one of the strongest means of protection for our coast and the entrance to our harbors.

The necessity of strong defenses for our own coast is growing constantly, but the knowledge of such necessity is not of a very recent date. It is now 15 years since the socalled Endicott Board reported to the War Department what was done in Europe for similar purposes, and laid out plans for a complete system of protection for our seaboard, indicating the places to be fortified, the number and caliber of guns, mortars, torpedoes and so on. The board's recommendations also comprised armored protection for the large caliber guns which were in particularly important and exposed positions. Armor turrets were recommended for 44 16-inch guns and armor casemates for 80 12-inch guns. The question as to the material of which the protective armor should be made was left open for further experience, although the board sent expert officers to Europe to study this question and had their reports on the subject.

In the very year when the report was completed, 1886, Gruson's armor was tested by the Italian Government, near the harbor of Spezzia, and with such success that an order for two 16-inch turrets was given at once. These turrets, the most formidable coast fortifications in the world, are now erected at Spezzia and Tarento, Italy. The Spezzia trials, at which representatives of our War Department were present, one officer each of the engineer's and ordnance corps, have demonstrated that for the purposes of the shore chilled iron armor was superior to any other and practically invulnerable. A great number of such turrets have since been built for European countries and elsewhere by the German firm.

OUR COAST DURING THE LATE WAR.

In this country, although the revolving iron turret for coast defense originated with an American (Th. R. Timby in 1841), war was considered such a remote possibility that little was done for the protection of our prosperous seaboard. When the war with Spain broke out we had a number of modern guns ready and the work on others was pushed to the utmost: of gun carriages only a few were completed, and it took considerable time before even a very insufficient number of guns could be made ready for service. As to armor, there was nothing available and no time or opportunity to provide it.

Fortunately our coast was in no real danger from such an enemy as Spain, and the fear which arose with the beginning of the war soon subsided.

We have peace now in which to prepare in time for another war. Much of the work during the late war was of a temporary character, done in haste and for the express purpose of meeting an emergency. It was recognized that it was necessary not only to have good guns of superior caliber and range, but also to give such modern ordnance the right kind of mounting and proper protection according to their location and importance.

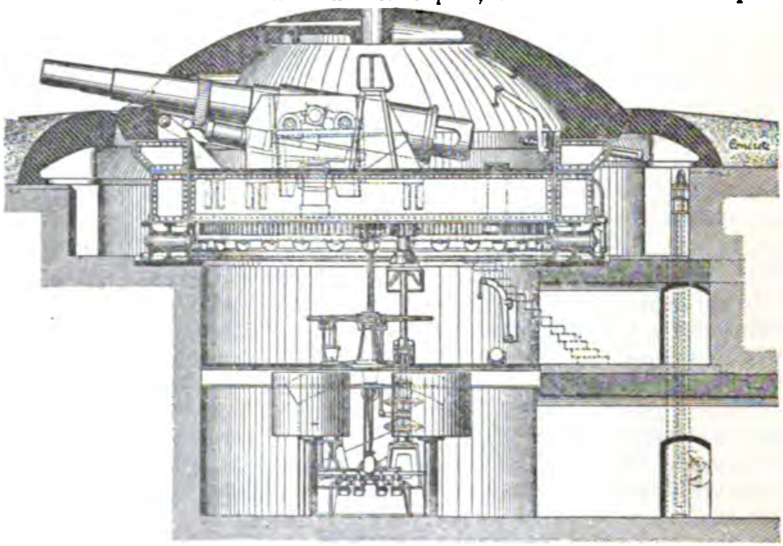
The Famous Buffington Crozier disappearing gun carriage was designed to meet these requirements, and is in itself a masterpiece of mechanical construction, as it brings the gun under a protective plane running on an incline of 7 degrees backward from the top of the parapet. There are many positions on the coast in which it would well fulfill the conditions necessary to a proper defense, which, together with its mechanical excellence and ease of operation, leads to its use in positions where an angle of 7 degrees is quite insufficient, and where an open pit does not provide the necessary protection for the guns and gunners.

Gruson armor turrets and special construction of gun carriages are now looked forward to as an adequate means to fulfill these requirements.

THE GRUSON TURRET.

In the figure we present a vertical section, showing the general details of construction. As will be observed, it consists of a dome shaped superstructure of armor plates mounted on a substructure of steel plate construction, somewhat similar to the drum and turntable of a modern swing bridge. The plates used in this construction are entirely different from those employed to protect battle ships. They are made of a special quality of cast iron, being hardened by surface chilling to a considerable depth. The plates or sectors which make up the fortification or turret are double curved and of varying thickness, as shown in the illustration. and are held together by large steel keys, imbedded in the contact surfaces, no bolts or rivets being used, and the whole presenting a smooth and unbroken surface.

A number of such sectors, varying according to the size of the turret, form the circumference of the flat dome or cupola, and two half circular plates



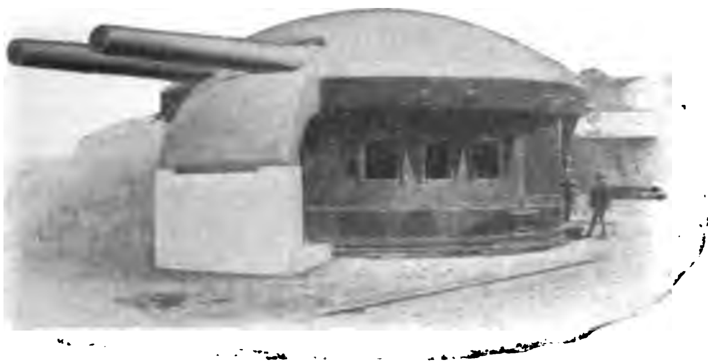
form its roof, its sectors giving protection on the breast and the roof plates giving protection overhead. The dome rests on a substructure made of steel plates and strengthened with angle irons. Large steel beams run across to carry the carriages on which the guns are mounted. This substructure is provided with a cast iron roller path, resting on a number of conical flanged rollers, the axles of which have their bearings in a live roller ring, which keeps them in proper relation to each other. The conical shape of the rollers allows them to revolve, without the aid of a central pivot, on a stationary roller path imbedded in the masonary.

The cupola is surrounded by the so-called "glacis armor," which forms a ring of double curved chilled cast iron plates, somewhat similar to those used for the cupola, but which are stationary and protect the substructure gun carriages and the machinery by which the turret and guns are operated.

The glacis armor is itself protected by a construction of granite and concrete. The turret can be revolved either by hand, steam, hydraulic, electric or other power.

To revolve the turret by hand a capstan is provided which transmits its revolutions through gearing to a pinion and racer fastened to the open roller path. The larger turrets are generally revolved by steam power, for which purpose a two-cylinder engine is placed in the lower gallery. The starting lever for this engine is operated from the middle gallery. Both hand and steam power can be made interchangeable by suitable mechanical apparatus, thus providing against a contingency of a failure of either.

In order to stop the the turrets from revolving spontaneously, especially when the guns are fired singly, a suitable brake is attached to the substructure, consisting of hydraulic cylinders controlled by proper valves, whose pistons press against a brake ring cast on the lower roller path for this purpose. The hydraulic cylinders are connected by pipes to a pressure transformer in the center of the turret. The dome is perforated by two portholes from which protrude the guns, and which so closely surround them that no projectile from the outside can penetrate into the interior of the turret. In order to make this possible the guns are mounted on special carriages, technically known as Gruson Minimum Port Carriages.



VIEW OF THE DRUM OF THE TURRET WITH THE DOME ABOVE.

These provide for the elevation and depression of the gun around a pivot near the center of the embrasure, instead of having these movements take place on the trunnions of the gun. Such an arrangement makes it necessary to lift or lower a considerable weight with every change in the elevation of the gun. This is performed by means of accumulators which are kept in action by a special set of high pressure pumps.

A counterpoise to the recoil of the gun is obtained by two hydraulic cylinders, one placed on each side of the gun. The cylinders are secured to the gun itself while piston rods are fixed to the substructure of the turret. It will also be observed that a link connecting the piston rod with the substructure of the turret allows for the elevation and lowering of the cylinders, which are fixed to the gun, as stated before.

The traversing of the guns is effected by rotating the turret, the amount of such motion necessary to a proper sighting being regulated by the commanding officer, who has his station in the center of the cupola and makes his observations through an orifice in the dome, which also contains a sighting apparatus.

A hoisting mechanism and hydraulic ram connected with the ammunition chamber below is provided for loading the guns.

The points which make the Gruson turret practically invulnerable are its extreme hardness of surface, its shape of flat curved dome or cupola, its great thickness and mass, and the iron glacis ring surrounding it.

COMPOSITION, TESTS, ETC.

The hard surface is obtained by a special composition of the best charcoal irons as raw material and casting in very heavy iron chilling molds. A depth of the hard crust or chill of several inches, grading off very gradually into the softer mass of gray iron, is thus obtained. The chilled surface is so hard that it can only be worked by emery, and it is impossible for any projectile to penetrate it. The curve of the dome is so designed that any projectile arriving with a high velocity and, therefore, more or less horizontally, will strike the plates under an acute angle not over 45 degrees. The point of the shell will therefore be of no avail and find no hold on the armor, nor will a soft steel cap on the projectile help it, but the side of the shell will strike the hard surface, and as tests have shown, the projectile will glance off in fragments. The small striking angle causes only a fraction of the shell's energy to take effect, while on a vertical armor surface the whole of it would have its effect. The local effect of a single hit on the plate results in a flat abrasure of the surface and in some cases in the forming of fine cracks. Repeated hits on the same part of the plate will naturally increase the abrasures and number of surface cracks, but it is said do not produce any considerable change on the inner surface of the armor until four or more hits concentrate on one and the same plate.

The great mass of the armor protects against a shattering effect from heavy armor piercing projectiles, and the displacement of any of the plates or the whole turret. A single plate in a coast defense turret weighs from 50 to 90 tons, and in a turret, for instance, there are 15 such plates forming the circumference and two half circular plates, the sides of each circumference plate converging toward the center, making the plate a gigantic wedge, carefully fastened to its neighbors by strong steel key plates. Comparing such a construction with a ship's cylindrical steel plate turret, the difference is at once apparent. An experiment made at the Indian Head Proving Ground in 1896 with a ship's steel turret for two 8-inch guns showed that a 12-inch projectile dislodged the whole structure.

As for the use of Gruson turrets on board ship, the chilled cast iron armor is much too heavy and takes up too much room. On a war vessel the armor must be of material which combines resistance to penetration with lightness, because it must stand the impact of armor piercing shells under an angle of 90 degrees, or approximately that. The ship's turrets must take the risk of displacement in order not to imperil the ship's buoyancy and then the ship has the advantage of changing position. On shore there is practically no restriction as to weight, shape and size of the armor construction, but the shore turret must be prepared against a concentrated fire and cannot change position.

At the trials near Spezzia, Italy, in 1886 the sides of the Gruson plate were set into solid rock, its back being left free and its hardeded convex surface facing the attacking gun. It received a fire of a 100-ton Armstrong gun with Krupp steel armor piercing projectiles weighing one ton each at a distance of only 150 yards without noticeable disintegration. The four guns in the

turrets at Spezzia and Tarento, Italy, are similar to the so-called "big gun" exhibited in the Krupp pavilion at the World's Fair in Chicago, 1893.

The first of the American 16-inch guns is to be completed some time this year, and it is expected that it will be more powerful than the Krupp gun of like caliber. It will be recalled that the forgings were made by the Bethlehem Steel Company, and the gun is now being assembled and machined at the Watervliet Arsenal. It will, when finished, be mounted at the Sandy Hook Proving Grounds on a provisional carriage for trial purposes before further orders for this type of gun are given. After the trials are completed it is believed that this gun will be mounted at Romer Shoals, at the entrance of New York harbor, and covering the new channel. This is an exposed position for which the Gruson turret is considered especially adapted.

The fact that it could only be obtained abroad has until now been a serious impediment to having chilled iron armor in this country, and the War Department was not allowed to give contracts to a foreign maker. At the same time Congress could not be expected to make appropriations for this material as long as there was no one here to manufacture it. But, encouraged by the experience of the war with Spain and the outlook for the future, and convinced of the necessity of armored fortifications, American enterprise has established the means to provide for building Gruson armor from American materials by American labor in this country.

—*Iron Age*, December 28, 1899.

**Gruson Turrets for Coast Defense. A Statement Submitted to the Board of Ordnance and Fortifications of the United States Army.**

New York, February 28th, 1900.

In presenting the question of Gruson chilled cast iron turrets to the Board we are bringing forward no novel proposition—no inventor's idea that is still a matter of "blue-prints" and estimated results, but a system of gun protection which has passed through all the experimental stages, and which has stood the severest tests known outside of those of actual warfare—a system which years of experience and millions of dollars have contributed to develop to the fullest extent, and one which has been adopted by many foreign governments after the most deliberate consideration. It is now appropriate to present it to the United States Government, because for the first time it is possible to produce these turrets in this country, to build them on our own soil, of domestic materials and with American labor. Doubtless many, if not all the members of the present Board are familiar with the Gruson Turrets, but it may not be amiss to give a brief sketch of their history.

The form and construction of the Gruson Turret can be seen from the working model which we exhibit, and the blue-prints of drawings, the photographs and literature, which are presented for the inspection of the Board. The drawings show the latest development of the turret, and are offered as an explanation of the manner in which it would be built to-day, the working model representing an earlier type of turret.

These turrets have, up to the present time, been built only by the Grusonwerk at Magdeburg-Buckau in Germany. Prior to 1890, this concern furnished to the German Government nine turrets, one of which contains two 5.91 inch guns, three contain two 11.02 inch guns, and five contain one 11.02 inch gun each. All of these turrets were built between the years 1875 and 1879. The Austrian Government, between the years 1881 and 1883 were fur-

nished with three of these turrets, each of which contains two 11.02 inch guns. Holland secured two of these turrets in the years 1882 and 1883, each containing two 12.01 inch guns, and between the years 1884 and 1886, the Dutch Government procured three more turrets, one of which contains two 5.91 inch guns and the other two contain two 9.45 inch guns each. The latest order of the Dutch Government was filled during the years 1888 and 1890, and was for two turrets, each containing two 9.45 inch guns. The Italian Government in 1886 ordered turrets for four Krupp 15.75 inch guns which were mounted at Spezia and Tarento. Belgium has also purchased turrets for her large guns, and turrets for smaller guns have been bought by Switzerland and Roumania. Brazil has also bought one turret for 10 inch and one turret for 11 inch guns. These were shipped last year. The turrets in Holland containing the 12 inch guns are at Harssens, others at Ymuiden, Hoek van Holland and Pampus. The turrets containing the 11 inch guns in Austria are at Pola and a number of smaller turrets elsewhere.

The details as to the number of turrets purchased by foreign governments since 1890, and the exact places where these turrets have been established (other than those given above) are not at hand, as the governments have made the matter confidential in placing their orders with Grusonwerk. We have the description of 40 turrets actually built and sold between the years 1872 and 1891 which number has been largely increased since then. Without going more particularly into this phase of the subject, it is enough for the present purposes to show that foreign governments have invested large sums in these turrets, *and have continued to add to their investment over a long series of years.* This is the best evidence of their belief in the Gruson Turret.

A trial was made of the Gruson Turret armor at Spezia, Italy, in the year 1886, which called the attention of the whole professional world to this form of gun protection. The weight of the plate for the trial was 193,895 pounds and it withstood three shots from the Armstrong 100 ton (16.93 inch) gun, in which Krupp steel projectiles were used at a range of 150 yards. The weight of the projectile was 2,205 pounds, while the charge consisted of 827 pounds of one-hole, brown, prismatic powder. The actual energy developed amounted to 47,566 foot tons. At this trial, representatives of the U. S. Engineer and Ordnance Corps were present, and doubtless the files of the Department contain more complete reports of this trial than those to which we have access.

Even before this test, the attention of the so-called "Endicott Board" was called to the Gruson Chilled Cast Iron Armor and to their form of turret, as one that was well adapted for the needs of our coast defenses at certain points, and Captain Bixby, U. S. A., went to Germany and officially investigated the subject. In the report of the Board (printed as Executive Document No. 49, 49th Congress, 1st session) they say that the shore batteries which they recommend "may be armored turrets revolving or fixed," etc. (see page 49) and they recommend such turrets as part of the defenses of the ports of New York, San Francisco and Boston, and at Hampton Roads, Narragansett Bay and Key West.

They give the number of the turrets (each containing two guns) which they recommend for the several localities above mentioned; and in connection with the prices which will be spoken of later on, it is interesting to note the amount the "Endicott Board" estimated that these turrets would cost.

Their items are as follows :

| PLACE. | ARMOR. | STRUCTURAL METAL. | MASONRY, ETC. | TOTAL. |
|---|---|---|---|---|
| NEW YORK, 9 2-gun turrets . . | $4,050,000 | $450,000 | $1,800,000 | $6,300,000 |
| SAN FRANCISCO, 5 2-gun turrets . . | 2,250,000 | 250,000 | 1,000,000 | 3,500,000 |
| BOSTON, 4 2-gun turrets . . | 1,800,000 | 200,000 | 800.000 | 2,800,000 |
| HAMPTON ROADS, 2 2-gun turrets . . | 900,000 | 100,000 | 400,000 | 1,400,000 |
| NARRAGANSETT, 1 2-gun turret . . | 450,000 | 50,000 | 200,000 | 700,000 |
| KEY WEST, 1 2-gun turret . . | 450,000 | 50.000 | 200,000 | 700,000 |
| TOTAL, 22 turrets . . | $9,900,000 | $1,100,000 | $4.400,000 | $15,400,000 |

The facts and figures above quoted are found in the report, pages 13 to 25.

As an appendix to the report of the "Endicott Board," a report is printed of a sub-committee, dated July 13, 1885, and signed by General Benét as Chairman. In this the following statement occurs : "Chilled cast iron manufactured by Gruson in Germany has received favor upon the continent of Europe, and has been partially introduced in various defensive works both on the sea-coast and for land fortifications. It endures the fire of small guns extremely well, but has not been tested with calibers above 12 inches or with energies exceeding 15,000 foot tons." This statement is quoted for the purpose of calling attention to the fact that the report was made a year previous to the trial at Spezia, and at a time probably when not more than one third of the Gruson turrets now in existence had been constructed. It is interesting to note that even these earlier types of Gruson Turrets had proved that they were extremely good defenses against the fire of smaller guns, in view of the fact that protection from the fire of rapid-fire guns of small caliber has recently attracted such a large amount of professional attention.

Since the report of the "Endicott Board," the Gruson Turret has been presented from time to time to various Boards and Bureaus of the War Department by the representative of Grusonwerk, (which a few years ago consolidated with the firm of Fried. Krupp,) but the matter, however, was not actively taken up, owing largely to the fact that there was no emergency and a consequent apathy of public interiest, and doubtless, also, because these turrets could only be procured from a German firm and it would have been impossible to obtain a congressional appropriation to procure them. In 1898, however, the emergency arose. Public interest was aroused to the highest degree in all matters pertaining to national defenses. The patriotic generosity of Congress put the War Department in a position to push forward the long considered plans of the officers of the United States Army and with characteristic energy, during the past two years, they have materialized their scheme of coast defense to a point where it is now appropriate to seriously consider the addition of this widely recognized type of fortification, in those positions which are peculiarly adapted for it. Moreover, and above all, it is now possible to have these turrets made in this country.

Just prior to the outbreak of the Spanish-American war and when conflict

was impending, a citizen of the United States obtained personally from the firm of Fried. Krupp Grusonwerk the right to manufacture the Gruson Turret, accompanied with all the information at the disposal of the German firm. This gentleman was Mr. P. H. Griffin, of Buffalo, N. Y., probably the best known and largest manufacturer of chilled cast iron car wheels in the world, and one who is thoroughly familiar with the making of all kinds of chilled castings. Considering the time at which this arrangement was made, and the very large cash payment by which Mr. Griffin secured this right and information, his patriotic motive must be admitted in gaining the position where those secret processes and methods, hitherto jealously guarded, could be at the disposal of this Government. After the Spanish-American war he associated with him Mr. C. W. Barnum of the Barnum Richardson Company, of Lime Rock, Conn., the manufacturers of the famous "Salisbury Cold Blast Charcoal Iron," which has been used by the U. S. Government for many years, and other gentlemen connected with prominent iron manufacturing interests in this country, who joined in organizing a corporation called "Gruson Iron Works" which was incorporated under the laws of the State of New York in the Spring of 1899. This corporation has secured the services of Captain A. E. Piorkowski, I. G. A., who theretofore had been the representative of Fried. Krupp Grusonwerk, in this country, and of Mr. David Townsend, of Philadelphia, who has had an experience of 23 years in handling and casting chilled iron. Mr. Griffin transferred to this corporation his agreement with Fried. Krupp Grusonwerk, and it now has the sole and exclusive right to use in this country the plans, secret processes and methods of manufacture employed by Fried. Krupp Grusonwerk in the making of Gruson Turrets, chilled armor plate for coast defenses, and other war materials used in connection with the same. Under the said contract, the firm of Fried. Krupp Grusonwerk have not only conveyed the exclusive right (as above stated) to use their processes and information, but have agreed to instruct and educate our people so as to put them in a position to successfully carry on in a proper and complete manner the manufacture of Gruson Turrets. Mr. Townsend has spent considerable time in the works at Magdeburg, and the employees of the Gruson Iron Works will receive personal training from the German experts.

The business office of the Gruson Iron Works is at 31 Nassau Street, New York City, and after a thorough investigation it has acquired a manufacturing site at Eddystone, one mile from Chester, Pennsylvania, on the Delaware River. This site now has a depth of 25 feet of water at the bulkhead line. Two railroads traverse it, the Pennsylvania and the Reading, and the Baltimore and Ohio touches it and can be easily brought on to the property. It consists of 185 acres, particularly well adapted for the purposes contemplated, and its character and the plant to be erected upon it are shown on the blue-prints submitted. The contract for the first building of the plant has been placed, and construction will be begun as soon as the weather permits. The plan of the company is to at once erect a plant for the production of heavy rolling-mill work, rolls (both sand and chilled) and general machine castings, with a machine shop well equipped with proper tools for turning out the above class of work. The plant will be erected with the idea of at any time enlarging it for the purpose of making Gruson Turrets; the necessary buildings for which are projected and provided for in the present plans shown on the blue-prints.

Those interested in the Gruson Iron Works feel confident that they can

satisfy the representatives of the United States Government that they have had long practical experience, and can manufacture the Gruson Turrets at Eddystone (or elsewhere in this country, if necessary) within any reasonable time after the award of a contract, and also of their ability to fulfil their engagements, as well as to control the technical expert knowledge necessary to success.

Of course, in order to put the Board in a position to consider the advisability of recommending Gruson Turrets, it is necessary and proper that it should be informed of the probable cost of these turrets, as far as it is possible to estimate the cost of a manufacture in which the cost of the raw material is liable to fluctuate and the price of labor is an element. Estimates made today might be absolutely valueless a year hence. In submitting figures, therefore, the Gruson Iron Works presents them as approximate and in no sense as a bid, which, of course, could not be made in advance. The cost of each turret, moreover, would be affected by its location and the distance from the factory, so that it would be necessary to have detailed specifications as to the engineering work, excavations, foundations and masonry. The only figures that can be given are the figures on the turret, its necessary appurtenances and mechanism and the gun carriages. A table of the parts and approximate weights designed to contain two 12 or two 16 inch guns each is submitted. The letters refer to the parts marked with similar characters on blue-prints Nos. 149 and 150, also submitted. These tables show that the approximate weight of the 12 inch turret is 1,640 gross tons and of the 17 inch turret 2,589 gross tons. The cost of this material can be roughly estimated at the price quoted to the Board. This cost includes the erection of all the various parts as far as it is necessary to do the same at the factory, which generally includes the cupola, glacis armor, roller track, substructure and independent mechanism. It also includes taking apart, marking and loading on cars or boat and all ready for transportation. It does not include any transportation, erection in position or firing trial of gun carriages, all of which would vary with the location chosen and the distance from the factory. It would take about fifteen months from the receipt of the order to make the first turret at the Company's works at Eddystone, owing to the fact that the plant would have to be enlarged and special machinery constructed. After the completion of the first order, turrets could be manufactured at the rate of from three to five a year.

Taking as a basis of calculation, the maximum price suggested to your Board, the cost at the Gruson Iron Works of the twenty-two turrets (for two 12-inch guns each) recommended by the "Endicott Board" would be at least thirty-three per cent. less than that Board's estimate, owing to the possibility of now making these turrets in this country. It must be borne in mind that the Government is expected to furnish the guns.

The Gruson Turret, when once established, is easily maintained, owing to its simplicity of construction, its solidity and minimum risk of deterioration. It requires less repair than any other kind of fortification, owing to the fact that the guns and carriages and interior structure are so thoroughly protected from the elements and its form is so compact. It is not brought forward to take the place of any existing form of fortification, but for use in locations at which it is necessary to fortify advanced positions at or about the sea level, where its form renders it inconspicuous and presents a very small target to an enemy, it being possible to render it almost undiscoverable in the absence of buoys, lights, ranges and the ordinary aids to navigation. It is suggested

that a pair of turrets ordered for some harbor where they would be placed on sand, or soil free from rock, would entail but a minimum cost for excavation and furnish the most satisfactory test of the merit and economy of the system.

Its merits are submitted for the serious consideration of the Board, and (if a committee is appointed to investigate the subject) the Gruson Iron Works is ready to submit all the information at its command, and to place at the disposal of the Board the experts in its employ, who will attend in response to notice sent to the undersigned.

Respectfully submitted,

WARD, HAYDEN & SATTERLEE,

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New York City.

HERBERT L. SATTERLEE,
OF COUNSEL.

**Austrian Rapid Fire Field Guns.**

For many years experiments have been conducted in Austria with rapid fire guns, which may shortly come to an official close.

The Austrian field service is now supplied with the material of 1875. This is made up of guns of two different calibers, one a 7.5 cm. (3.0 inch), the other a 8.7 cm. (3.5 inch), measured across the lands; guns of the latter caliber, commonly called 9 cm. are supplied to the field and horse batteries.

Various alterations were made in this material in the year 1897, in an endeavor to increase the rapidity of fire, and thereby the efficiency, but the study of a rapid fire gun of 7.5 cm. (3.0 inch) was never neglected.

For a short time a rapid fire gun of 7.8 cm. (3.2 inch) was also considered, but was abandoned. During this time of delayed progress, care was taken to make use of all knowledge which other nations were acquiring with the field typé of rapid fire guns.

The guns which were tested were made either entirely of steel or of steel bronze with a steel lining tube.

Further experiments soon led to the abandonment of the all steel gun. The Austrian Artillery Board has for the present adopted a rapid fire field gun and a rapid fire mortar. From various sources, such as the *Revue d'Artillerie Revista di Artiglieria e Genio*, we learn that the field gun outfit has been tested, up to the present time, in four different forms; in three of these the gun recoils on the carriage and the shock is taken up by an hyraulic buffer, supplemented by a strap, rope or chain brake.

Choice still lies between two systems of breech mechanism : a wedge block, opening to the left, and an interrupted screw fermeture, which is an adaptation of the Nordenfeldt. In all the systems tested the possibility of turning the piece laterally in the carriage was insisted on; all the carriages have wheel brakes, and the charge is contained in a metal cylinder. The length of recoil does not exceed one half a meter.

The projectile is a shrapnel of the model of the year 1896. It is 3.5 calibers long, weighs 6 kg. (13.2 lbs.) and contains 250 filling balls of 13 g. (4.5 oz.) each. The charge is 1.1 lbs. The initiel velocity is 1775 f. s.

Besides the shrapnel, shell with combination fuze are provided, which constitute one fourth of the total supply of ammunition. As heretofore remarked, besides this flat trajectory gun, there has been adopted a high angle fire piece,

a mortar. Before the test of the latter was begun, trials were made in Austria with a 12 cm. (4.7 inch) howitzer, but it was not adopted.

It was shortly after this proposed to employ in the field service the 15 cm. (6.0 inch) mortar and howitzers of the siege train. The excessive weight of these guns, however, precluded their adoption.

Coeval with the rapid fire gun, the rapid fire mortar was tested, of this, however, but little has been made public.

At any rate the field mortar will be of larger caliber than the gun and most likely a return to the 12 cm. caliber will be decided upon.

We submit that Austria's new field artillery should engage our most earnest attention, since, not only does the Austrian artillery possess men of undoubted ability, as has been repeatedly recognized and acknowledged, but it is most important to watch results and thus take advantage of experiments made with rapid fire guns by others.

Translated from the *Militär Wochenblatt*, of March 7, 1900, by

Charles A. Junken,
Ordnance Office, War Department.

## WARSHIPS AND TORPEDO BOATS.

### The Imperial Japanese Navy *.

BY REAR-ADMIRAL C. C. P. FITZGERALD, ASSOCIATE.

It is thought that a short account of the navy of Japan will be of interest to the members of this Institution, and having lately returned from that country myself, and had the opportunity of seeing some of their ships and dockyards, I have undertaken to collect a few facts and figures on the subject, with the view of laying them before this meeting. The rise and development of the Japanese navy is, probably, without precedent in the world's history. When I visited Japan for the first time, in 1858, the navy consisted of some junks, and a few ships which were said to have been built and rigged on the models of Dutch ships of the seventeenth century, and they certainly looked like it. In July, 1858, her Majesty Queen Victoria presented the *Mikado* with a small steam yacht of about 400 tons. She was called the *Emperor*, and was presented at Yeddo (Tokyo) by Lord Elgin to the Japanese Commissioners deputed by the Shogune to receive her. The *Mikado* did not make use of her; at that time he was not allowed out. I believe this to have been the first steamship possessed by Japan.

The first real start made by Japan in the production of a modern navy seems to have been the purchase of the ironclad *Stonewall Jackson* from the United States Government in 1866. She was a small ship of only 1300 tons burden, but she carried a 10-ton gun, besides some smaller ones, and was a powerful ship of her day; she was renamed the *Adzuma*. The first ship built in England for the Japanese Government was the *Foo-So*. She was built at Poplar by Samuda, from designs by Sir Edward Reed, and was launched in April, 1877. She was a broadside central battery ship, barque rigged, 220 feet long, 48 feet beam, 3718 tons, double screw, speed 13 knots, engines by Penn. This ship was followed by the *Kon-go*, *Hi-yei*, and *Rin-jo*, all small ironclads not exceeding 2000 tons, but carrying powerful armaments for their size. There were also half a dozen unarmored ships of little fighting value. This was the state of the Japanese navy in 1880. Five years

* Institution of Naval Architects, April, 1900.

latter—1885—Japan had only added one small ironclad to this list; but there were "built and building" for her several fast and powerful cruisers, armed with Krupp and Armstrong guns. The ironclads, with the exception of the *Foo-So*, were built of wood. Five years later—1890—she had again only added one ironclad to her list, in the shape of an armored gunboat; but she had by this time provided herself with a considerable squadron of fast and well-armed cruisers, built in various foreign countries. By 1895, although she had not actually added to her list of armored ships, there were building for her in England two battleships of the most powerful type, exceeding 12,000 tons displacement, and with a proposed speed of 18 knots; she had also added considerably to her list of fast cruisers. One of these—the *Yoshino*—built at Elswick, had a measured-mile speed of 22.5 knots.

There can be no doubt that the Chino-Japanese war gave an immense impetus to the development of the Japanese navy; not only were ships captured from the Chinese, some of which were repaired and are now in commission, but large orders were placed abroad for warships of all classes, including torpedo craft, and the Japanese also set to work to build ships in their own dockyards. The Japanese navy now stands as follows, eliminating ships which appear to be of insignificant fighting value, but including those which are expected to be ready during the current year:—

*Battleships.*

| | |
|---|---|
| *Fuji* | Thames Ironworks. |
| *Yashima* | Elswick. |
| *Shikishima* | Thames Ironworks. |
| *Asahi* | John Brown and Co. |
| *Hatsusi* | Elswick. |
| *Mikdsa* | Vickers and Co. |

These are first-class battleships in the fullest sense of the term, ranging in tonnage from the 12,300 of the *Yashima* to the 15,000 of the *Asahi*, *Hatsusi* and *Mikdsa*. Their speeds are all at least 18 knots, and they are armed with the most powerful modern guns, and considerable areas of their sides are protected by the latest and most up-to-date face-hardened armor. Four of the six carry more armor and more guns than British first-class battleships, but less coal. There is also the *Chinyen*—late *Chin Yuen*—captured from the Chinese, German built. I have seen her quite lately. She has been thoroughly repaired, and is now in commission, and although she cannot be classed as a first-class battleship, being of only 7220 tons, and 14 knots speed, she is a powerful ship of her class. There are also three small ironclads—*Fuso*, *Hi-yei* and *Kon-go*—built in England in the seventies—before alluded to -and the *Hei Yen* captured from the Chinese; they are of very small fighting value, and three of them are used as training ships.

*Armored cruisers.*—Although Japan won the battle of Yalu with second-class cruisers fighting against armored ships, her statesmen are not under the delusion that second-class cruisers will be sufficient to meet the growing needs of their rapidly expanding empire, and they are, therefore, adding to the fleet six very powerful armored cruisers of about 9800 tons displacement and about 20 knots speed:—

| | Tons. | Speed. | Armament. |
|---|---|---|---|
| *Tokiwa*<br>*Asama*<br>*Idzumo*<br>*Iwate* | 9750 | 21.5 | Four 8-in., fourteen 6-in., and twelve 12-prs. |

These are all Elswick ships, designed by Mr. Philip Watts. The *Tokiw* and *Asama* are completed, the *Idzuma* will be delivered about the middle of this year, the *Iwate* towards the close of it. The *Adzuma*, of 9436 tons, but the same armament, and 20 knot speed, is building at St. Nazaire, by the Société de la Loire, and is to be ready this year. The *Yakuma*, of 9850 tons, and the same speed and armament as the *Adzuma*, is building at the Vulcan Works, Stettin, and I am informed she is to be ready this year. The above ships constitute a squadron of six extremely powerful vessels, call them what you will, battleships or cruisers; at any rate not a few of the so-called "naval experts" think such ships are fit to "lie in the line" and take their place amongst battleships. They are at least as powerful vessels as some that are classed as second-class battleships in our own and some foreign navies, and they have a great advantage in speed. Japan owns another armored cruiser, the *Chiyoda**, built in Glasgow in 1890, with a nominal speed of 19 knots; she is a small ship of only 2450 tons, and she cannot be assigned a very high fighting value in the present day, though she took part in the battle of Yalu.

*Unarmored Cruisers. Second-class.*

| | Tons. | Speed. | Armament. |
|---|---|---|---|
| *Chitose* | 4760 | 22.5 | Two 8-in., ten 4.7-in., and smaller guns. |
| *Kasagi* | 4784 | | |
| *Takasago* | 4160 | | |

The *Chitose* was built at San Francisco, the *Kasagi* at Philadelphia, and the *Takasago* at Elswick.

| | | | |
|---|---|---|---|
| **Yoshino* | 4150 | 22.5 | Four 6-in., eight 5-in., and smaller guns. |

This ship was built at Elswick.

| | | | |
|---|---|---|---|
| **Akitsushima* | 3100 | 19.0 | Four 6-in., six 5-in., and smaller guns. |

This ship was built in Japan.

| | | | |
|---|---|---|---|
| **Naniwa* | 3650 | 18.7 | Two 10-in., six 6-in., and smaller guns. |
| **Takachiho* | | | |

Built at Elswick in 1885.

We come now to a group of a peculiar type of cruiser, carrying one very heavy gun forward, and a battery of light guns on the main deck aft.

| | | | |
|---|---|---|---|
| **Matsushima* | 4210 | 16.0 | One 12-in., eleven 5-in., and smaller guns. |
| **Itsukushima* | | | |
| **Hashidate* | | | |

NOTE.—The ships marked * took part in the battle of Yalu.

The two former ships were built in France in 1889; the latter in Japan two years later. Such an armament appears to be out of place in a cruiser, and a nominal speed of 16 knots to be inadequate. It does not appear that this type is likely to be repeated.

*Third-class cruisers and small craft.*—Japan possesses several third-class cruisers of good speed, capable of acting as scouts. She has also a considerable number of small vessels of low speed and but little fighting value, which it would be waste of time to describe. But there are six gunboats of the *Chinto* class, captured from the Chinese, carrying one 11-inch gun. These might be useful as coast defenders.

*Torpedo flotilla.*—The peculiar nature of the Japanese coast line, with its numerous harbors, and the Inland Sea with its archipelago of islands, are physical features in Japan which offer special advantages for the use of torpedo boats: and she is, therefore, providing herself with a powerful torpedo

* Institution of Naval Architects, April, 1900.

flotilla of the most modern type of vessels. Messrs. Yarrow, Thornycroft, Normand, and Schichau are all building either torpedo boats or destroyers for the Japanese Government, and some are also being built in Japan. A torpedo transport on the plan of our own *Vulcan* and the French *Foudre* is projected, but my information does not enable me to state whether the order has actually been placed or not. Yarrow and Co. have just completed six destroyers of 31 knots speed and upwards, and the same firm has now in course of construction ten first-class torpedo boats for the Japanese Government. Thornycroft and Co. have also just completed six destroyers of about 50 tons less displacement than the Yarrow boats, and with speeds of 30 knots and over. Japan already has in commission and in reserve, a considerable number of first and second-class torpedo boats, some of these being constantly used for exercise. It is interesting to note that an armor-plated torpedo boat named the *Katoka*, 166 feet long, with 9 feet 6 inches beam, built for the Japanese Government by Yarrow and Co., in 1885, led the torpedo attack both at Port Arthur and Wei-hai-wei. It seems that the Japanese not only know how to order a good article, but to use it when they get it.

*Dockyards.*—There are three Imperial dockyards in Japan—Yokosuko, Kuré, and Sassebo. They are all capable of being effectually defended. A fourth, Maisuru, on the north-west coast of the main island, is also in course of construction. Sassebo can only be approached through narrow and tortuous channels, and, from its natural position, may be considered absolutely unattackable from the sea. Kuré is in the Inland Sea, and its position also is naturally a very strong one; the Islands arount it are being strongly fortified, and it will shortly be impregnable to sea attack. It may, moreover, be remarked that with the powerful torpedo flotilla Japan has already got, and is still further increasing, hostile ships operating in the Inland Sea would be likely to have a bad time. Yokosuko is in the gulf of Yeddo, and very favorably placed for defense. The heights around are already fortified, and the works now in progress at the entrance to the gulf will protect not only Yokosuko, but also Tokyo and Yokohama, and forbid this large stretch of enclosed water to any hostile squadron. Nagasaki, where there is a private shipbuilding yard that turns out large merchant steamers, and where there is one first and one second-class dock, is being strongly fortified; and from its position it is a place of strategic importance. At Hakodati, in the North Island of Japan, the harbor is being artificially improved, and, although there is no dockyard here, the port is being fortified as a harbor of refuge. This place bears a striking resemblance to Gibraltar. At Oterrani, also in the North Island, extensive harbor works are in progress, an interesting description of which was given in *Engineering*.

Up to the present the Japanese dockyards have not undertaken to build a battleship, and the largest cruiser they have built is the *Hashidate*, of 4200 tons and 16 knots speed; but they hope soon to be able to build first-class cruisers at Yokosuko, and eventually battleships. At this dockyard there is a first-class modern dock, in which one of the heaviest battleships in the British Navy—the *Victorious*—was lately docked for cleaning purposes, and I never saw a similar operation more quickly, more quietly, nor more methodically performed in any English dockyard. In the *Jiji Shimpo* (*Times* of Japan), of February, 1899, Mr. S. Sassow, Chief Director of Naval Construction, writes as follows concerning Yokosuko dockyard :—"This dockyard was established during the Tokugawa regency by the Shogunate in 1866. French officers, comprising naval constructors and engineers—Mons. Verner being

the chief director—were engaged, together with a considerable number of leading workmen, for originating the work and for instructing Japanese workmen; several wooden ships have been built here. In 1875 the services of the greater part of the French employés were dispensed with, and the administration passed entirely into our own hands. . . . We are now building entirely of steel. Our artisans in all branches of shipbuilding and engineering have now attained to a considerable skill. . . . Hitherto the limit of size at Yokosuko has been 5000 tons; but it is intended to enlarge the dockyard so as to be able to build cruisers of all classes; and in course of time we expect to be able to build battleships. All materials have to be purchased abroad, even for building cruisers."

With regard to steel armor plate manufacture Mr. Sassow says:—"Should such be established in Japan, it would hardly be able to manufacture plates within six years from starting. With the experience of six years even they will probably find that it will be only after many years of further experience they are able to turn out plates of uniform thickness." Under these circumstances, the armor-plate manufacturers of Great Britain need not feel any immediate alarm of dangerous competition from Japan.

*Personnel.*—It is not proposed to say much concerning the *personnel* of the Japanese navy, as this Institution is more concerned with *matériel*, yet a few words on the subject may not be out of place. From the first awakening of Japan her statesmen seem to have grasped the fact that it would be useless to have a modern navy on the European model without having officers and men trained to work it; and, as it takes longer to train men than to build ships, they started at a very early stage to make provision for the training of their *personnel*. Not only was the British Admiralty applied to for permission for Japanese officers to serve in our ships—which was freely granted—but they were also asked to lend experienced officers to go out to Japan, and undertake and organize the systematic training of both officers and men on an adequate scale. Admirals Sir Richard Tracey, Wilson, Douglas, and Ingles, are amongst those whose talents and zeal are now reflected in the very high state of efficiency to which the officers and men of the Japanese navy have attained, as instanced by the able manner in which their ships were worked during the whole of the operations in their late war, and the high state of smartness and efficiency in peace time, which latter has come under my own personal observation.

The marvellous power of assimilating new ideas and new methods, entirely foreign to all their national traditions and the practice of centuries, which the Japanese have exhibited during the last few years, is a subject which has frequently been commented upon; but only those who have seen their ships in commission, and visited their dockyards in working hours, can fully realize the significance of the wonderful strides they have made during the comparatively short period which has elapsed since they set to work to create and to maintain a modern navy. Their zeal, their earnestness, their close attention to small but essential details, as well as their power to grasp broad principles, must be seen to be appreciated. I have heard it said that the Japanese are mere imitators, that they can copy European ideas and methods up to a certain point, but that they have no initiative, and that if they ever have to engage in hostilities with a Western naval Power, where unforeseen conditions of strategy and tactics may arise, they will break down under the strain, and prove to be unequal to the task. That is not my opinion; and, although this is not the proper place to discuss politics and strategy, I ven

ture to predict that when any future disturbance of the peace shall occur in the Far East, Japan will not only have something to say in the matter, but will make her voice heard and respected.

Since writing the above I have received the following piece of information concerning the Japanese navy:—"A grand naval review is to be held, commencing in April. It is intended more for mobilization purposes than for mere display. The entire naval forces of the country will be in commission, divided into two fleets, comprising in all about forty-four ships, to which must be added the torpedo boat destroyers and torpedo boat flotillas. After the manœuvres are over his Majesty the Emperor will inspect the fleet."

There are four appendices to this paper, which give particulars, now pretty generally known, of the *Shikishima*—see *The Engineer*, November 4th, 1898—*Idzumo* and *Iwate*—*The Engineer*, September 22nd, 1899—and a number of torpedo boats.

—*The Engineer*, April 6, 1900.

# INDEX TO CURRENT ARTILLERY LITERATURE.

## PERIODICALS CITED.

Abbreviations employed in index are added here in brackets.

All the periodicals are preserved in the Artillery School Library, Fort Monroe, Virginia.

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10, *Wine Office Court, Fleet Street, London, E. C. Per year* £1 10 *s* 6 *d.*

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6 *Rue de la Chaise, Paris. Per year* $1.00.

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26 *Rue de Grammont, Paris. Per year* 30 *Fr.*

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*Darmstadt. Per year* 24 *M.*

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Changes in the armies and navies of the world.—Int. Rev., May, June.

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Machine gun horse artillery companies.—S. Monatschr., April.

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Navel tactics in war (illustrated).—**Seewesens**, VI:
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The art of skirmishing.—**Jour. R. U. S. I.**, May.
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A German opinion on the conditions of modern war.—**R. Mil.**, France, May.
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The revival of Cossack tactics.—**Jour. U. S. I.**, India, April.
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The training of troop leaders.—**Beiheft**, 3.
Combined maritime operations (Capt. Walker).—**Naval Inst.**, March.
The war and its lessons (Sir G. S. Clarke). **Naval Inst.**, March.
Russia and England : a future campaign against India.—**Porvenir**, March 16.
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The points of support of the fleet.—**R. G. de Marine**, May.
The defense of coasts.—**R. Mill.**, France, April, May ; **R. G. de Marina**, May.
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The fleet in the service of a war on land.—**Jahrbuecher,** May.
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Military considerations on the Campaign in Cuba.—**Memorial,** April.
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Our position across from England.—**Marine F.,** May.
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The Russian railroad conquest in central Asia.—**Unit. Serv. Mag.,** June.
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The operations of Moltke and those of Napoleon compared.—**Int. Rev.,** June, Suppl. 15.
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The military leaders of the Boers. –**Rev. of Rev.,** May.
The battle of Rossbach.—**Beiheft,** 3.
The Second Boer War.—**Unit. Serv. Gaz.,** April 21–June 30.
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Some of the fighting with the Ladysmith relief column.—**Unit. Serv. Mag.,** June.
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Our naval heroes,—Sir E. Boscowen, admiral of the blue.—**Unit. Serv. Mag.,** June.
Mountain warfare in the Tyrol in 1809.—**Uuit. Serv. Mag.,** June.
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The Spanish-American War.—**R. Mil.**, France, February, April.

History of the French infantry.—**R. Inf.**, April, May.

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The general situation in Madagascar.—**R. Univ.**, May, June.

The campaign of the north army in 1792.—**R. Mil.**, France, April.

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An Italian artillery brigade in 1799.—**R. Artig.**, April.

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The army of the north under the command of Marshal Luckner.—**R. Mil.**, France, May.

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The Santiago Campaign.—**Circulo Naval**, April.

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Letters of Rev. Griffith Hughes (1733-1736).—**Penn. Mag.**, July.

## DISCIPLINE, DRILL REGULATIONS AND MANEUVERS.

The German maneuvers of 1899.—**R. Mil.**, France, February, March; **Cercle**, June 9, 16.

Instruction of engineer troops, and the reduction of the term of service to two years.—**Engenheria M.**, March.

English naval maneuvers of 1890.—**R. Maritime,** March.

The persistance of luminous impressions and rapid visual signals.—**R. Maritime,** March.

The new German infantry fiiring regulations.—**R. Inf.,** April, May.

Sub-caliber infantry target practice.—**R. Inf.,** April, May.

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The German field service regulations of January 1, 1900.—**R. Mil.,** France, April, May; **Int. Rev.,** May, **Beih.,** 9; **S. Zeitschr.,** April, May; **R. Cav.,** April; **Cercle,** Muy 19, 26; **Belgique M.,** April, May 20.

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Character, Knowledge and education in their relation to the army officer.—**Jahrbuecher,** May.

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A sterilizer for razors and surgical instruments.—**Scien. Amer.,** May 19.
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SEPTEMBER—OCTOBER.

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JOURNAL

OF THE

# UNITED STATES ARTILLERY.

VOL. XIV. No. 2. SEPTEMBER—OCTOBER 1900. WHOLE No. 45.

# THE SECOND BOER WAR.*

(Continued).

## III.

The British defeats at Magersfontein, Stormberg and on the Tugela closed the second epoch of the war. They were followed by a period of comparative inaction.

The mistakes in strategy of the second epoch, in trying to operate on three distinct lines, separated by from 150 to 300 miles,—one for the relief of Kimberley, another for the direct offensive from Queenstown towards Bloemfontein, and the third for the relief of Ladysmith,—and in splitting up the reinforcements for all these widely separated columns, instead of concentrating on one, brought their natural consequences, and the situation for the British became a very difficult one.

The tactical errors in applying an obsolete method of attack, in failing to develop a proper system of reconnoissance, and in neglecting to support field artillery by infantry or cavalry, the inferiority of the British artillery material at the opening of the campaign, the greater mobility of the Boer troops, as well as the inexperience of the British officers in exercising the higher commands, are the principal additional factors that have determined the events.

The obsolete method of attack consisted (on the Tugela, for example) in not preparing for the attack by a proper artillery bombardment from guns placed in well-covered gun pits; then following the artillery duel (insufficient in every case thus far) either too soon (before proper preparation) by the infantry attack (as on the Tugela), or leaving too long an interval (as at Magersfontein); finally, in deploying an insufficient number of

* In addition to the authorities previously cited, the author desires herewith to express his obligations to the following: *La Guerre au Transvaal: L'offensive des Boers*, Lt. Col. Frocard and Capt. Painvin, *Der Buernkrieg in Südafrica*, Major L. von Estorff, General Staff, Part II.

skirmishers for the firing line, *in line, firing volleys,* against an invisible, well intrenched enemy, and making only *frontal* attacks on the position.

Both sides were compelled to inaction for a long period: the British for want of complete trains, for laying bridges and to enable them to cut loose from the railroads; and the Boers for lack of any further reinforcements, which compelled them to economize their troops, and consequently prevented them from taking Ladysmith or Kimberley by storm, or from advancing any farther into the British domain.

The total number of British troops in South Africa on January 1, 1900, was about 103,400, of which 83,600 were unmounted and 19,800 mounted. The position of the troops was as follows:

Lord Methuen was in an intrenched position between the Modder and Riet rivers, just east of their point of junction, and covering a bridge over the two rivers as well as the railroad bridge. He had about 13,000 men. The Boers, under Cronje, Delaray and Prinsloo, about 20,000 strong, occupied a fortified position at Spytfontein-Magersfontein, both flanks resting on the Modder River, the left extending across the river to Jacobsdal. They were gradually closing in on Methuen, and stray parties threatened his line of communications, so he made an effort to clear up the situation to the southwest, and on the 1st of January sent General Babington with a part of the 1st cavalry brigade from the main camp, and Colonel Pilcher with a small detachment from Belmont, towards Douglas. Pilcher surprised a Boer detachment at Sunnyside and pushed on to Douglas, but the approach of a commando (500) of Boers along the Riet induced him to leave Douglas on the 3rd and return to Belmont. Babington also returned to the main camp without accomplishing his object.

A mixed force occupied Zoutpans Drift, about 20 miles east of Orange River station on January 6.

Grigualand West and British Bechuanaland have practically joined the Boers, and Kuruman, the capital of the latter, surrendered on January 2, with 12 officers and 108 men.

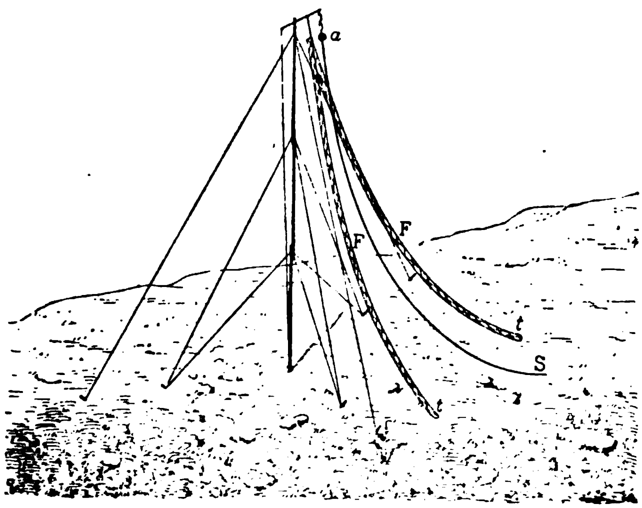
On the southern border of the Orange Free State Gatacre had retired towards Sterkstroom, French was at Arundel and Rendsburg, and Naauwpoort and De Aar were occupied by British reserves. On December 31, leaving in Rendsburg a half regiment and a section of horse artillery, French advanced with 5 squadrons of cavalry, 80 men mounted infantry and 10 guns against Colesburg. He occupied a position to the west of Colesburg and

made a demonstration in the direction of the railroad junction north of Colesburg. The Boers (1000) retired in the direction of Norvals Pont, but on the morning of the 3d of January, being reinforced, they returned and forced French to retire. He took up a position about 5 miles south-east of Colesburg. On the 6th he sent out Colonel Watson with a half battalion of the Suffolk regiment, to occupy a small height about 2 miles west of Colesburg, commanding the road to Phillipstown. Colonel Watson advanced in close column to the top of the hill, and there, while giving his orders for the occupation of the position to the assembled officers, was surprised by the Boers and lost one-third of his force. French remained operating in the vicinity of Colesburg.

In Natal the situation remained practically unchanged. Joubert, who had been absent ill since December 6th, had resumed command of the Boer forces north of the Tugela on December 18th.

### The Siege of Ladysmith.

Before proceeding to consider Buller's third attempt to relieve Ladysmith, let us interrupt the narrative of events in the active armies and cast a glance at the military situation in and about this beleagured city.




RECEIVING STATION, WIRELESS TELEGRAPHY.

Ladysmith, on account of its natural advantages, its position on the railroad and its situation (well to the north) in Natal, was long ago selected as a depot of supply and point of support for this colony. Had it been properly fortified and adequately

supplied with supplies and material, as well as with a strong infantry garrison, in addition to the necessary artillery, it would probably never have been besieged, or if so it could have held out indefinitely. As it was there were, at the outbreak of the war, only four months provisions on hand, and about three hundred rounds of ammunition per piece. A few batteries of heavy guns on the surrounding hills, with strong bridge heads on the Tugela at Colenso and on the Bushman and Mooi Rivers, would have protected the city as well the line of communications. But the British underrated the power of the two Republics and so were loth to make the proper preparations. Had the Boers been trained in siege operations the place would probably have fallen.

The town lies in a valley, on both sides of the Klip river, and is commanded on all sides by high hills, which, on the north, run in a ridge close to the river, on the south consist of more isolated hills, separated from Ladysmith by a broad plain. Outside of this nearer chain of hills is another line encircling them but rising somewhat higher.

The position of White was on a ridge beginning at Helpmakar Hill east of the town (nearly half way between the town and Lombards Kop) and running in a horseshoe bend to the north of it, bending in the west and around by the south-east of the town, near the railroad bridge over the Fouries Spruit. In front of this general ridge on the south side, several other points were occupied: Maiden Castle, Bester's Hill and Waggon Hill. The British position encircled Ladysmith, on the east at about 1½ miles, on the north close against the town, on the west at over 2 miles, and on the south at about a mile. The entire line measured about 13 miles, for the occupation of which White had originally about 12,000 troops, but this strength rapidly diminished to 9,000.

Outside of White's lines there was no high ground nearer than about 6,000 yards from the center of Ladysmith, which was a great advantage for the British. The Boer lines occupied the nearest chain of hills outside of the British lines, and this was about 3 miles on the north of Ladysmith, and 5 miles on the west and south.

The 14 works composing the British line were occupied as follows:

| | |
|---|---|
| Helpmakaar, | 1st battalion Devonshire Regiment. |
| Cemetery Hill,<br>Tunnel Hill, | 1st battalion Liverpool Regiment. |
| Junction Hill, | 1st battalion Gloucestershire Reg't. |

| | |
|---|---|
| Gordon Hill, Leicester Hill, | 1st battalion Leicestershire Reg't. |
| Cove Redoubt, | Naval Brigade (*Powerful*). 2nd battalion Rifle Brigade. |
| Kings Post, | Kings' Royal Rifles. |
| Range Post, | 2nd battalion Royal Dublin Fusiliers. |
| Red Hill, | 1st battalion Royal Irish Fusiliers. |
| Highlandman's Post, Maiden Castle, | 2nd battalion Gordon Highlanders. |
| Caesar's Camp, Waggon Hill, | 1st battalion Manchester Regiment. 2 squadrons Imperial Light Horse. |

The guns were distributed as follows :

| | |
|---|---|
| Cove Redoubt (opposite Pepworth and Isimbulwana hills) | One 4.7 in. navy gun. |
| Junction Hill | One 4.7 in. navy gun. |
| Gordon Hill | Three navy 13-pounders. |
| Ladysmith | 6 field batteries (36 guns). |
| | Several 3-pdr. Hotchkiss guns. |
| | Two mountain guns. |
| | One machine gun for each infantry battalion and cavalry reg't. |

The Boer lines were 24 miles in extent, and were occupied by a force varying continually between 10,000 and 20,000 and by 22 guns :

| | |
|---|---|
| Pepworth Hill | "Long Tom" (15.5 cm. or 6 in.). |
| (4 m. north of the town) | Two 12-pdr. field guns. |
| | Two 37 mm. R. F. guns. |

"Long Tom," rendered unserviceable by the British, was replaced by another piece of the same kind.

| | |
|---|---|
| Isimbulwana Hill | "Slim Piet," (6 in. Creusot). |
| Valley bet. Pepworth Hill and Surprise Hill | 2 British guns captured at Nikolson's Nek. |
| Surprise Hill | One 4.7 in. howitzer. |
| | (Destroyed by the British). |
| Lombard's Kop | One 4.7 in. howitzer. |
| Between Lombards' Kop and Isimbulwana Hill | Three field guns. Two 75 mm. mountain guns. |
| Beyond Caesar's Camp | One 4.7 in howitzer. One field gun. |

Other guns were behind the Kopjes west of the town, and were moved about from point to point as required.

| | |
|---|---|
| In reserve | One 37 mm. R. F. "Pom-Pom." |
| | Several Maxim guns. |

The British had, therefore, but five guns which could reach the Boer guns of position, and these were the navy guns. Without them they would have been helpless.

Communication from Chieveley Camp with Ladysmith was kept up by means of a heliograph station on Mount Umkolumba, near Weenen, under Captain Kayser. The latter was in almost daily communication, and by the middle of January had sent over 41,000 words. There were also several balloons in Ladysmith, which did excellent service.

On January 6 the Boers made a strong attack on the British lines, especially on the out-lying heights of Waggon Hill and Besters Hill. Some of the positions were taken and retaken three times during the day, but the Boers were repulsed. The British lost in this action 14 officers killed, 25 wounded; 135 men killed, 244 wounded.

The Boers lost (according to their own reports) 54 killed, (including 5 field cornets) and 96 wounded, total 150.

It is remarkable that Buller did not attack the enemy with more energy at the same time that the latter attacked White, for Buller and White still communicated by heliograph, but he contented himself with a demonstration towards the Hlangwane Hill (east of Colenso), consisting merely in an artillery bombardment of the Boer position, to which the Boers did not even reply. His only chance of helping White effectively was by way of Springfield, for White's attack was towards the south, and he would naturally avoid the enemy's strong position at Colenso, in case he broke through the lines in his front, and strike westward.

This is the military situation at the beginning of the third act of the war.

Two grand movements open the third act. In Natal General Buller decided on turning the right flank of the enemy's position by an advance over Springfield, Potgieter's Drift and Trichard's Drift on Acton Homes and Dewdrop; and in the west General Roberts developed his plan to turn the Boer position in his front.

### THE CAMPAIGN IN NATAL.

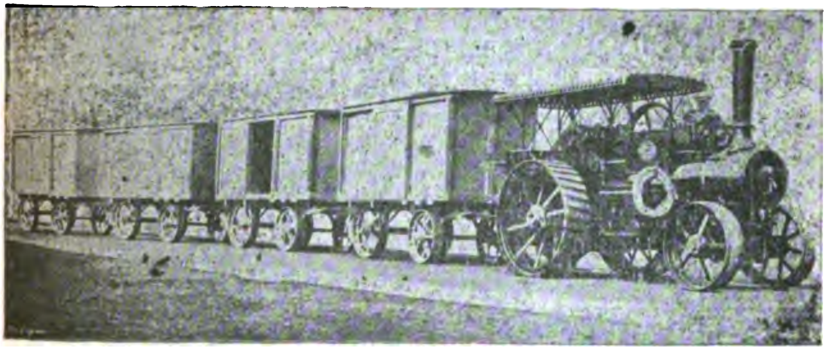
### The Second Attempt to Relieve Ladysmith.

### Battles on the Upper Tugela.

The Boers occupied the plateau and rugged ridges constituting the foot hills of the Drakenberg Mountains, from Acton Homes, over the Tabayama Hills and Spion Kop to Groeblers Kloof, and after the battle of Colenso had remained behind the Tugela,

merely sending out patrols from the fortified Hlangwaneberg, and in the west over Springfield.

For some time after the Battle of Colenso General Buller had devoted his time to drawing in his reinforcements, concentrating at his headquarters in Frere all available forces, a large supply train, and a number of traction engines for the transportation of



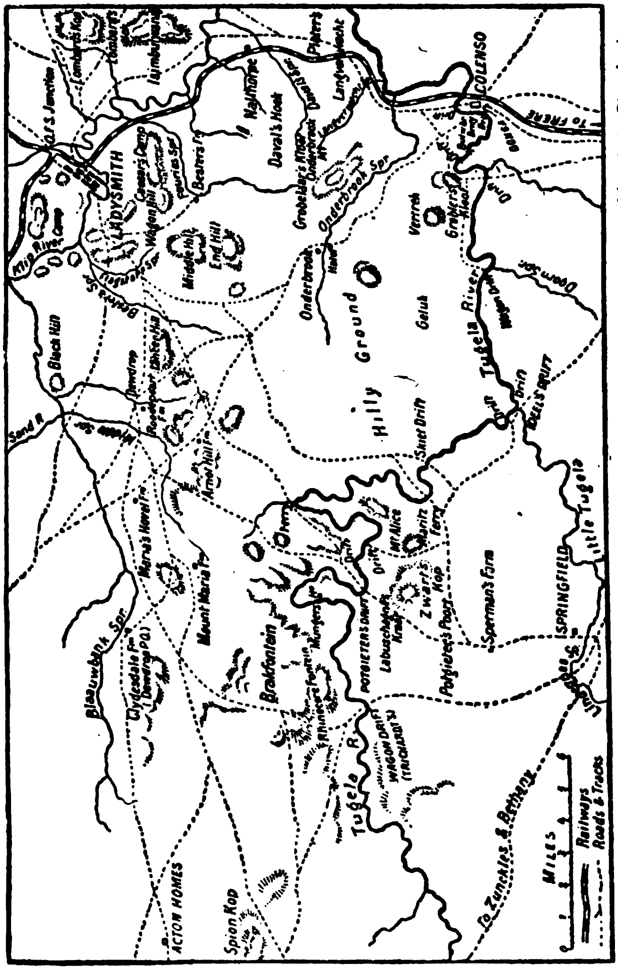
TRACTION ENGINE AND TRAIN.

his artillery. The country as far as Springfield was carefully reconnoitred. A narrow gauge road was also laid from Frere to Springfield. The enemy was deceived by feints indicating a projected advance around his left flank over Weenen.

General Buller's entire force comprised about 25,000 men.

Leaving only Barton's brigade (and several navy guns) at Frere to hold the enemy in front, and cover his lines of communication, he directed the rest of his command (about 20,000 men) westward towards the upper Tugela. The advance guard cavalry brigade of Dundonald and Warren's Division left Estcourt on January 10th, and the brigades of Lyttleton and Hart (under General Clery) left Frere on the 11th, Hildyard's brigade following on the 12th. On account of the long train of 400 wagons and 5000 draught and pack animals, and the precautions taken to insure safety, as well as the bad condition of the roads from heavy rains, Buller did not reach Springfield till the 13th, where a day's halt was ordered. Clery's Division was then sent on the road to Potgieters Drift, Dundonald and Warren on the western road to Trichards Drift, Buller's headquarters being located at Spearman's camp, a farm on the southern slope of the Zwarts Kop. His general plan was to hold the enemy in front at Colenso by means of Barton's brigade, to attack his right flank by Clery's Division in a northerly direction over the road between the Arnot Kop and the Brakfontein Kopjes or over the

plateau to east of the Arnot Kop, pressing forward towards Ladysmith, but first to turn the Boer right flank by means of Dundonal's and Warren's columns, roll it up, secure the roads to Oliviershoeck and the Bezouidenhout Pass, and join Clery's Division over Dewdrop.



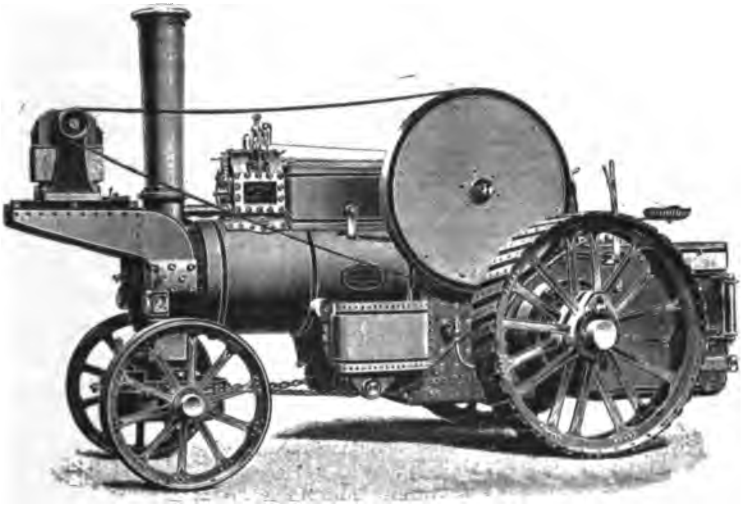

D'après le Standart.

Les champs de bataille de la Tugela.

THE UPPER TUGELA.

General Buller's operations, in spite of all the difficulties in the way, were so well concealed, that the enemy was not aware of his real plan until he had crossed the Little Tugela and occupied the Zwarts Kop, although the movement of his columns had been noticed and in a general way preparations to receive his attack were made.

At Springfield provisional magazines were established for supplying the troops, and the enemy's position was carefully reconnoitred by means of anchored balloons.



TRACTION ENGINE WITH DYNAMO AND SEARCH LIGHT.

The ford at Potgietersdrift was secured on the 11th, and on the 16th half of Lyttleton's brigade and a howitzer battery crossed the Tugela there. Six howitzers were promptly placed on One Tree Hill and the latter occupied, while the heavy guns were taken up Zwartz Kop on the south bank to cover the position on the north. Coke, with part of his brigade, was placed below Zwartz Kop to observe Schiets Drift, the remainder of his brigade guarded the train and lines of communication. The advanced position of the Boers on the spurs of Brakfontein Kopjes, immediately in front of Lyttleton separated him completely from General Warren, who after constructing a pontoon bridge at Trichards Drift, crossed there on the 18th. Warren had also part of the 2nd and 3rd Divisions. Dundonald moved rapidly to the left, cleared the western side of Acton Homes, but Warren decided that the position of the Boers was too strong to turn so he ordered Dundonal to fall back to Trichard's Drift on the 19th, and directed his attention to the Spion Kop, which appeared to be the key to the position.

*Action at Venter Spruit.*

General Warren, on January 19th, had decided to modify his orders. Meanwhile, the Boers were making preparations to meet his attack. General Botha at Colenso received orders on the 19th to repair to the Upper Tugela and assume command.

He rode all night and at 3 A. M. on the 20th arrived in the camp of General Schalk-Burgher. The position was inspected and the disposition of the troops made.

On January 20th, General Warren placed two brigades (Woodgate's and Hart's), and 6 field batteries under General Clery to attack the Boer position. The latter was in the form of a semicircle around an amphitheatre containing Three Tree Hill. The Boers had not had time to construct trenches, but they built up with stones rude ramparts on their lines of defense.

The British advanced in two columns. One (comprising the 1st battalion South Lancashire Regiment and the 2nd battalion Lancaster Regiment of Warren's brigade) deployed and moved out against two kopjes,—Three Tree Hill and another to the east of it. The other (comprising the rest of Woodgate's brigade and all of Hart's) advanced to the west of Three Tree Hill and remained massed under cover. Hildyard's brigade remained in reserve.

The ascent of the kopjes was very difficult, and it was not until 7 A. M. that the artillery came into action on Three Tree Hill, at about 2500 yards from the Boer defenses. At 7.30 A.M. the hill to the east was occupied by the British, when the Boers opened a heavy fire of musketry. At 11 A. M. the west column received orders to advance.

The Boer position was naturally very strong. The ground was broken and covered with rocks for the first part of the British advance, but for 1000 yards from the Boer lines there was an open, gentle slope down toward the British position. The artillery of the latter also had very little effect against the Boer defenses.

At 3 P. M. the British artillery opened a rapid fire, and then the entire line started to advance over this open ground. The attacking troops, however, could make no headway, and gradually turned into the valleys instead of going up the slopes, and so the order to halt was given. At 7.30 P. M. fresh battalions from Hildyard's brigade were sent in to relieve the Lancashires.

The artillery of the Boers replied only at intervals to that of the British: constantly changing its position, and rarely firing more than three shots from any one.

Meanwhile, Dundonald's mounted brigade was active on the left of Hart's brigade, and took a hill about 1700 yards to the west of the latter, holding it all night.

The troops bivouacked in their positions at night. On the extreme right Lyttleton made a demonstration in force against

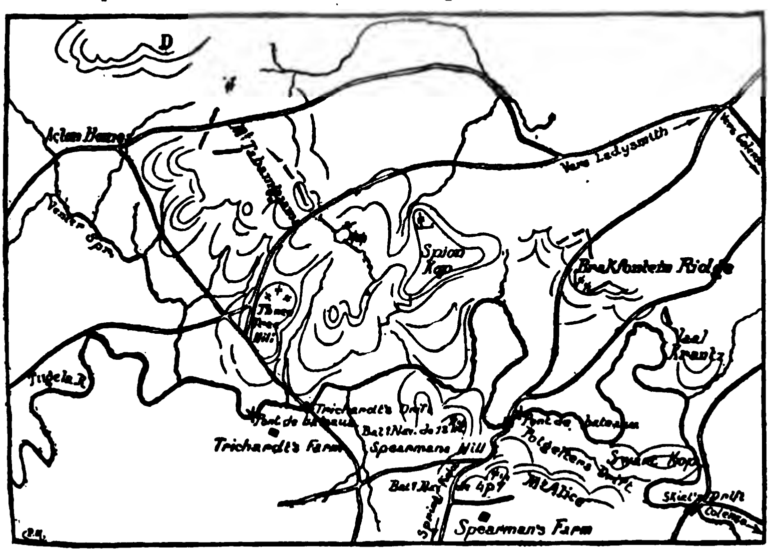
the Boer position opposite Potgieter's drift, but found the latter still strongly occupied. On the morning of the 21st it was found that the Boers on the right of their line had retired to a second line of crests defended like the first. The British occupied the line abandoned by the Boers.

The British artillery had great difficulty in coming into action on this day, because the position on Three Tree Hill was now out of range of the Boers, and there was no nearer position (except on the plain) available. Two field batteries were sent by Warren to strengthen the left, and four howitzers were sent by Buller to reinforce Warren. Nothing was accomplished on the 21st. The two field batteries and the howitzers were placed on the plain between the Venter Spruit and the road to Acton Homes, and bombarded the Boer lines during the 22nd and 23rd, but produced no effect.

The troops in Ladysmith made sorties on the 20th and 22nd, but without result; and Barton, at Chievely, made a weak demonstration on Hlangwane Hill.

*Action on the Spion Kop.*

On the 23rd Buller in person joined Warren, and, since the Boer lines appeared to be very thin, an attack on Spion Kop was decided upon in order to break through them.




THE BATTLE OF SPION KOP.

General Woodgate was designated to command the forces, comprising the advace under Colonel Thornycroft (6 companies mounted infantry, 194 men, and one company of engineers) and

a reserve of two companies of the South Lancashire and the Imperial Light Infantry.

The height was scaled in the night of the 23rd and 24th, and at 3 A. M. the troops arrived at the summit, where they surprised and drove off a small Boer outpost. They at once intrenched, but a heavy fog prevented them from appreciating their real position. At 8 A. M. the fog raised, and they found themselves enfiladed by the Boers.

The outpost of Boers, driven off by the British, had given warning, and in the fog the Boers managed to bring five guns to bear on the British position, as well as two Maxim-Nordenfelts, and had sent up two strong columns to retake the position, so that when the fog raised at 8 A. M. they opened with artillery and musketry on the British trenches, and by 10 A. M. the British were driven to the southern extremity of the plateau. General Woodgate fell mortally wounded, and was succeeded by General Coke, who arrived in the afternoon with reinforcements, but later Colonel Thorneycroft was assigned to the chief command. The two battalions of Coke's brigade were sent as reinforcements and arrived about noon.

The extreme right, under Lyttleton, continued its efforts against Brakfontein, and also sent reinforcements to Thornycroft: the Scottish Rifles and the 60th Rifles back over Potgieters Dritt, and up stream to a ford where they again crossed to the north side, then the former went up Spion Kop by the same path as the original troops; while the latter followed along the foot of the Spion Kop, then up to the north salient of the east side.

The arrival of these reinforcements during the afternoon (4.30) enabled the British to hold out till evening. Preparations were being made to send up the 4th mountain battery and two naval 12-pounders, and part of Hildyard's brigade was assembled at the foot of Three Tree Hill, with orders to attack Tabamyama in the morning, but Colonel Thornycroft was not informed of these measures.

The troops on the plateau on the Spion Kop had suffered severely, and therefore Colonel Thornycroft decided to abandon the position in the night, commencing his retreat at 8.30 P. M.

On the 27th, General Warren's troops were taken to the south bank of the Tugela. The passage was accomplished without accident or loss, and the command deserves high praise for this feat, for, besides the troops and the guns (6 field batteries, 4 howitzers and the machine guns) there were 489 wagons, namely, 232 ox-wagons, 98 ten-mule teams, 107 six-mule teams, 52 four-mule teams.

Lyttleton's brigade was also partly drawn to the south bank, but the Zwatz Kop was held, as well as One Tree Hill.

Buller's plan was evidently to begin the turning movement at Acton Homes, but Warren, not being able to make any progress on the extreme flank of the Boer position, and recognizing the importance of Spion Kop, decided to fall back and take that first, with a view to then advancing on the Fair View-Rosalie road (branching to the right from the Trichard's Drift—Acton Homes road). In other words, he converted Buller's plan for a turning movement into what practically became again a purely frontal attack. He reported his decision at once to his superior, but the latter was too far away to control his actions in time. In a similar way, after Spion Kop was taken, it was abandoned, without consulting General Warren, by the immediate commander, Thornycroft (Woodgate having been wounded). In both cases orders were given by subordinates entirely upsetting the main plans of their superiors.

The forces at this time were distributed somewhat as follows:

The Boers had in all about 30,000 men,—12,000 at Ladysmith, 3000 at Colenso, and about 15,000 on the heights of the Tabamyama and Brakfontein.

The British had for the turning movement about 12,000 in all,—Littleton 3000, Hart 2000, Hildyard 3000, Woodgate 4000, and Dundonald 800.

The losses of the British in this turning movement were 216 killed, 671 wounded and 315 missing, that of the Boers is reported at 1200. Buller's total losses between the 17th and 24th amounted to 87 officers and 1652 men.

### The Third Attempt to Relieve Ladysmith.

*Battle of the Vaal Krans.*

On January 30th Dundonald's cavalry, in order to draw the attention of the Boers to their western flank, made a demonstration towards Hongers Port (11 miles above Waggon Drift), still further destroying the bridge there.

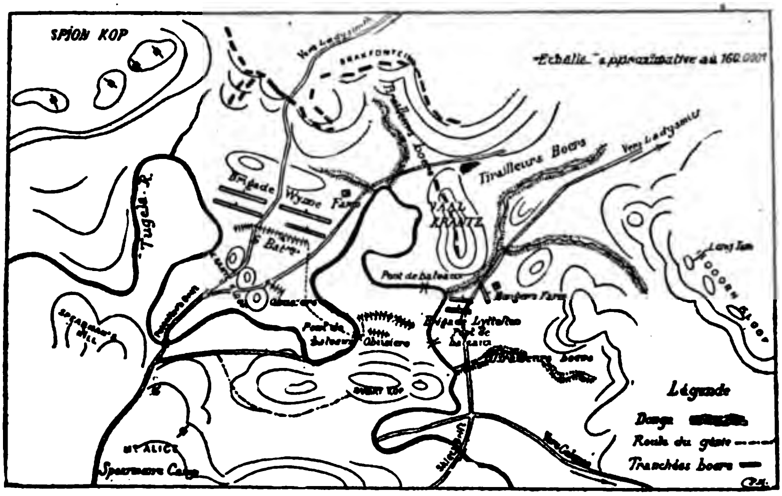
On February 3rd the British artillery on Zwarts Kop and Alice Hill opened a heavy fire on the Boer position north of the Tugela. Buller's object was to prepare for his advance over Potgieters Drift and Mole Drift, just below, his most direct route towards Ladysmith.

Opposite Potgieters Drift the first line of hills is that of One Tree Hill, and beyond that rises another ridge (a spur of the Brakfontein Kopjes) called the Vaal Krans. To the east of these hills, near the bend of the Tugela rises the Mole Spruit

Kop and further north the Dornkloof Berg, the latter permitting of a flank fire on the Vaal Krans, and being itself flanked by the western spurs of the Onderbrook plateau (especially the Krans Kloof).

The only position north of the Tugela, held by the British after the retreat of Warren over Trichards Drift, was the One Tree Hill ridge, about 1½ miles north-east of Potgieters Drift, which Lyttleton's brigade had occupied. The rest of General Buller's army was encamped between Spearman's Farm and Springfield.

On February 4th the British troops broke camp, Clery's division marching towards the valley behind the Zwarts Kop, while Warren's moved towards Potgieters Drift. Wynne's brigade (11th) and 6 field batteries crossed the Drift on the evening of the 4th and relieved Lyttleton's brigade.



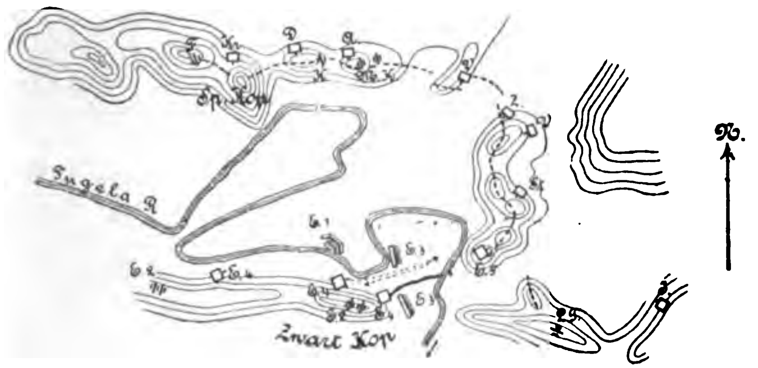

THE BATTLE OF THE VAAL KRANS.—*Cercle.*

The plan of attack was as follows:

Wynne's* brigade, with the field batteries, was to move over One Tree Hill and demônstrate against the Brakfontein heights, while the main attack was to proceed over a second ponton bridge (to be constructed farther east), directed against the southern spur of the Vaal Krans. The batteries with Wynne were to retire in echelon, and then support the main attack. In support of the general movement a battery of six 4.7 in. guns had been established on Mount Alice, and six navy 12-prs. and two field 15-pdrs. on the Zwarts Kop.

* Wynne succeeded Woodgate, the latter having been wounded.

The 1st brigade of cavalry (13th and 14th Hussars and a horse battery under Burn Murdock) was to attack the Brakfontein plateau on the right of Clery's division, while the 2d brigade (volunteers with a battery of machine guns under Dundonald) was to protect the right flank against a Boer advance from the Doorn Kloof; Coke's brigade was held in reserve. Buller had been reinforced by eight 6-inch howitzers from the siege train, and 3 batteries of naval guns.




BATTLE OF THE VAAL KRANS.—*Wochenblatt.*

Legend.

| | |
|---|---|
| ------- | Boer trenches. |
| L. T. | Long Tom, arrived from Ladysmith on night of Feb. 6. |
| M. K. | Maxim and Krupp guns, brought from Spion Kop. |
| K. | Krupp gun. |
| F. | Schneider gun. |
| J, St, V.V., Z,, A, D, Kr | Boer Laagers. |
| E 1. | British battery, entrenched. |
| E 2. | " howitzer battery. |
| E 3. | " field batteries (4). |
| E 4. | " infantry advancing. |
| E 5. | " " on evening, Feb. 5. |

On the morning of February 5th, about 7 o'clock, the British field batteries (five) moved out and took position, in front of One Tree Hill ridge, and opened fire, together with a howitzer battery farther in rear, and the six 4.7-in. guns on Alice Hill.

Wynne's brigade advanced slowly in open order. At 1600 yards from the enemy's position the advanced line halted.

Meanwhile Lyttleton's brigade moved along the foot of the Zwarts Kop and the engineers laid the second ponton bridge.

At 10 A. M. the first British battery limbered up and proceeded along the Tugela to the first ponton bridge and crossed over; the other batteries followed at intervals of half an hour. As soon as the artillery began this movement the Boer artillery opened at about 5000 yards. At 1 P. M. Wynne's brigade received orders to retire.

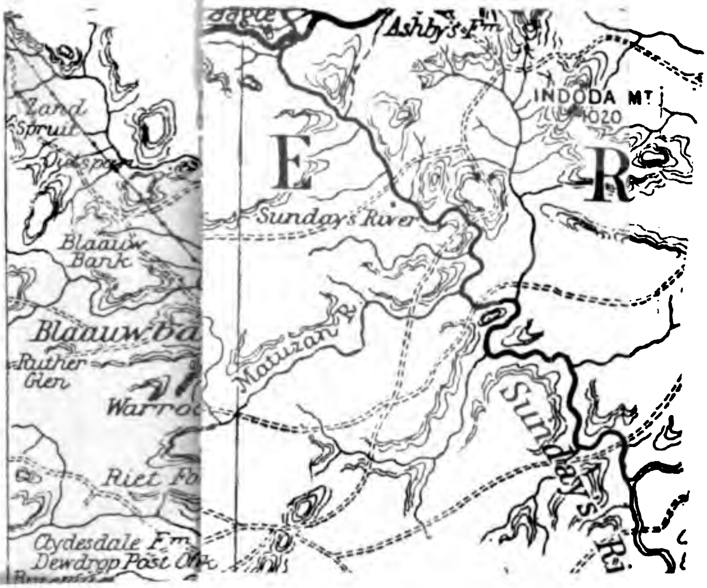
The second ponton bridge was completed at 12 M., practically without any losses. The batteries took position north-east of the Zwartz Kop, and, after felling trees to mask their position, opened fire and continued the bombardment for two hours, when the principal attack began.

Lyttleton's brigade crossed first and advanced against the Vaal Krantz. Mongers Farm on the British right flank was taken. Meanwhile, the artillery (70 guns), concentrated on the left flank, opened at 2400 yards on the Vaal Krantz ridge. The Boers were taken completely by surprise and the ridge was captured by the Durham battalion. But the Boers promptly took measures to meet the British advance, and guns were rapidly placed on the Brakfontein spurs. The Boer infantry, rapidly concentrating at the northern end of the Vaal Krantz, drove the British from the east side of this ridge. By evening of February 5th Lyttleton occupied about 1000 yards of the west side of the Vaal Kranz. The tactical value of the Vaal Kranz had been greatly overated, and it was now seen that from their position on it it was impossible to take the Boers in flank.

At sunset Hilyard's brigade relieved Lyttleton's. An attempt was made to capture the British position, but it was repulsed. During the night the Boers placed a 6-in. Creusot gun on the Doornkloof, and on the morning of the 6th opened on the British with musketry and shell fire. The position of the Boers was exceedingly strong, as the British advance would have been practically through a defile between the Spion Kop on the west and the Doornkloof on the east, both almost impregnable. Buller, instead of outflanking the Boer position, found himself outflanked, and since it became known through balloon reconnoisance that the Boers had placed a 6-in. gun in position on the Doornkloof, and it was recognized that the latter must be taken by a frontal attack to clear the road to Ladysmith, Buller gave orders at 9 P. M. on February 7th for the retreat over the Tugela to Spearman's Camp. Two days later the main part of the army was back in Chieveley.

The British lost 2 officers killed, 16 wounded; 24 men killed, 280 wounded and 5 missing.

In consequence of Buller's defeat the Boers began a number of demonstrations indicating a projected strategic advance against the British lines of communication. Joubert pushed out a considerable force over the Tugela towards Chievely, occupying Bloys Farm and the Doornkop; other troops crossed at Bridle ford (4½ miles west of Colenso), and at Robinsons ford


Ashby's Fm
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4020
Zand Spruit
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R
Sunday's River
Blaauw Bank
Blaauw ba
Matuzan
Ruther Glen
Warroc
Sundays Ri
Riet Fo
Clydesdale Fm
Dewdrop Post Off


The Battle of Pieters Hill.

(6 miles west of Colenso), threatening Buller's line of communication. Cavalry skirmishes took place beyond the east and west flanks of the British at Chieveley and Springfield.

In Zululand a Boer column of about 2000 men pushed on from Vryheid through Nqutuland and Ingogo, capturing the police station at Nqutu, and early in February took the Inkandhla magistracy, and threatened a move on Eshowe, the capital, 30 miles distant. Colonial scouts from north Zululand, however, occupied Eshowe.

### THE CAMPAIGN IN THE SOUTH AND WEST.

#### *Preliminary movements.*

During the period from the 6th of January to the 12th of February few movements of any importance took place in the southern and western theatres, but reconnoitring was carried on continually, and led to many minor engagements.

Lord Roberts arrived at Cape Town on January 10th, but awaited there the arrival of the 6th and 7th divisions.

General French, near Colesberg, displayed the greatest activity. His efforts were directed to taking Colesberg and securing the crossings of the Orange River at Bothos Drift and Norvals Pont, but he only succeeded in establishing himself on the heights south of Colesberg.

The British position at Colesberg was in the form of a wide semi-circle, south of the town, with the Coleskop (900 feet high) in the center, occupied by two 15-pounder guns. About 1000 yards south-west of the Coleskop the British held a small kopje, occupied by the Berkshire regiment, and 2 miles south-west of Coleskop they had Porters Hill occupied by two guns supported by a company of mounted infantry, while 2 miles farther south was the Rensburg camp; and about 3 miles north-west of Coleskop two squadrons of Lancers were posted. The Boers at Colesberg were commanded by De Wet.

On the 12th of February the Boers made an energetic attack and drove the British back to Rensburg. On the 13th the Boers continued the attack and forced the British (under Clements) to Arundel.

On the 26th of January the 6th division (Kelly-Kenny) arrived, and was sent over Port Elizabeth to Steynsburg and occupied Thebus, on the Rosmead (Middleburg)—Stormberg line (about 40 miles west of Stormberg). The 7th division (Tucker) arrived at Cape Town early in February, and was sent towards the Modder River.

On January 30th, Prieska, on the Orange River, 100 miles west of Orange River Station was occupied by a British force.

Colonel Plumer was encamped, early in February, at Krokodil Pool (about 65 miles north of Mafeking), with a strong Boer commando in his front, which held the kopjes commanding the road and river.

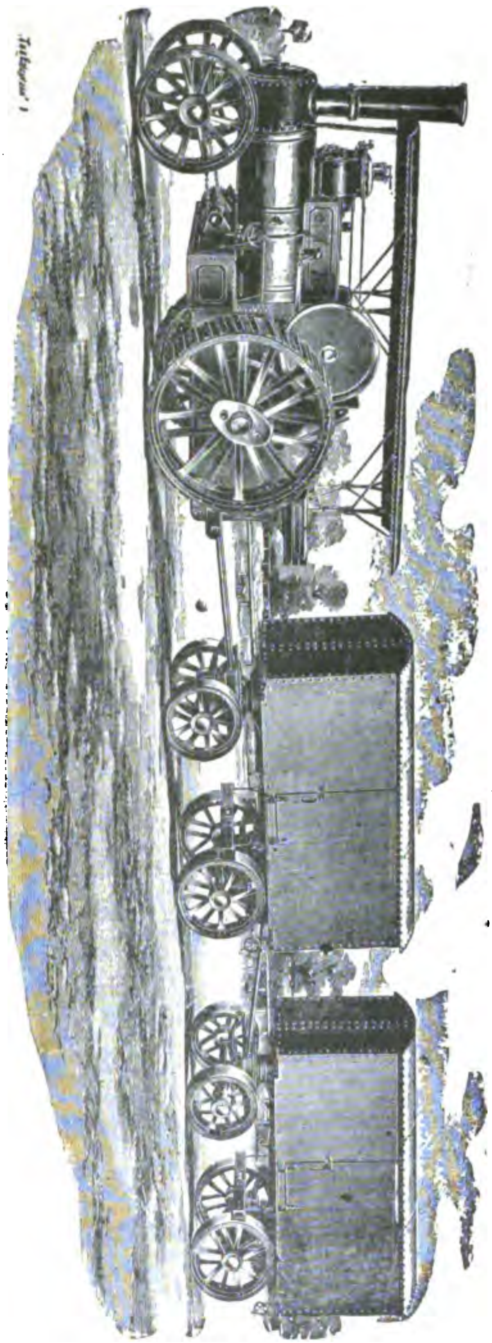
The Boers had abandoned their positions at Graspan and Belmont, in rear of Methuen's army, but on February 4th General Macdonald was sent with the Highland Brigade, the 9th Lancers and a field battery, to Koodoos Drift, in order to prevent at that point the union of two Boer commandos, which were advancing with a view to reoccupying Belmont. Macdonald failed in his attempt, and was defeated in the action which resulted. He lost 3 officers and 5 men killed, 4 officers and 35 men wounded. On the 9th he was ordered back to the camp on Modder River.

### Lord Roberts' Campaign.

The problem which Lord Roberts had to solve was by no means a simple one, but, for several reasons, he adopted the plan to take the 6th and the 7th division, as well as French's, and move to the east over Klip Drift, around Jacobsdal, on Bloemfontein, with a view to the speedy relief of Kimberley.

In the first place, Kimberley had nearly reached the limit of its powers of resistance, and although its garrison held 6000 Boers to the spot, and not available for the active field army, still its loss would add this force to the Boer army and deprive the British army of the garrison of 2,600 men and 78 guns, not to mention the necessity for saving the valuable diamond fields. In the next place, after the failure of Buller's third effort to relieve Ladysmith, it seemed useless to reinforce him and attempt any further movements in that difficult country, whereas an advance as projected in the western part of the Orange Free State would be over ground which would be in every way advantageous to the British. Moreover, such an advance would probably soon draw Boer troops from in front of Ladysmith, and at least improve the chances of Buller's breaking through their lines.

The difficulties of the situation are traceable to the original splitting up of the forces, in consequence of which the British are now in four columns separated respectively by 240, 64 and 144 miles, or 448 miles between the extreme columns, and they are tied to these lines on account of the extreme difficulty of withdrawing the immense trains (2000 transport animals and several hundred wagons per division), as well as the magazines of supplies and materials established on these lines. In addition,



TRACTION ENGINE AND STEEL CARS.

if an attempt were made to withdraw on any one of these lines, the Boers would promptly advance, and so threaten the communications on the others.

Moreover, Lord Roberts could not await the arrival of the 8th division (expected about the end of March), in order to build up an army of 50,000, and then advance into the Orange Free State according to the original plan, but was compelled to act promptly for the relief of the besieged places and of the general situation, with what forces were available for an advance, viz: the 6th and 7th divisions and Brabant's colonial troops, either against Cronje's army on the Modder, or against the Boer forces at Colesberg (Arundel) or Sterkstrom, leaving Buller in Natal to hold as many Boer troops as possible in front of him and away from the decisive theatre in the west.

On the 10th of February Lord Roberts arrived on the Modder River, and immediately proceeded to organize his army, gathering in all available cavalry and placing it under French, and filling up with volunteers and local troops, to form of the 6th and 7th divisions, recently arrived, together with the 1st division (Lord Methuen's) and the 9th brigade, an army of about 50,000 men, for an offensive advance for the relief of Kimberley against Cronje's army and Bloemfontein.

General Roberts formed his army into four divisions: 1st, Lord Methuen's, 6th, Kelly-Kenny's, 7th, Tucker's, 9th, Sir A. Colvill's (formerly commanding Guard brigade), and French's cavalry division, which had been ordered from Colesberg, Clements relieving French there.

The Guard brigade was placed under the command of Pole Carew (previously commanding the 9th brigade), while Colonel Douglas was given the 9th brigade. The 18th brigade was formed of volunteers and colonial troops (under Stephenson).

His train consisted of 700 wagons and 9000 pack and draught aninals.

General Roberts' Army.

| | | | |
|---|---|---|---|
| 9th Division. Colville. | | 7th Division. Tucker. | |
| 3d Brigade. Macdonald. | 19th Brigade. Smith-Dorrien. | 14th Brigade. Chermside. | 15th Brigade. Wavell. |
| 6th Division. Kelly-Kenny. | | 1st Division. Methuen. | |
| 13th Brigade. Knox. | 18th Brigade. Stephenson. | 1st Brigade. Pole Carew. | 9th Brigade. Douglas. |

Cavalry Division.
French.

| 3rd Brigade. | 2d Brigade. | 1st Brigade. |
|---|---|---|
| Gordon. | Broadwood. | Porter. |

His preparations were kept perfectly secret, and the activity of Buller in Natal, the appearance of Brabant's volunteers in front of Dordrecht, General Gatacre's movements and General Clements' resistance at Colesberg, all served to keep the enemy occupied, attracted his attention to other points in the theatre of operations, and prevented him from sending timely reinforcements to the Modder River.

The direction of Lord Roberts' attack was well considered. A front attack on Cronje's strongly fortified position at Spytfontein—Magersfontein was out of the question. A flank movement around Cronje's right flank, while it might relieve Kimberley, was tactically and strategically false, first, because Macdonald's operations near Koodoos Drift undoubtedly attracted the attention of the Boers in that direction, and secondly, because, even if successful, it would merely force Cronje back on his line of communications. An attack on Cronje's left flank had first to be directed on Prinsloo's strong position at Jacobsdal, then after that was taken, Cronje's position would be flanked, but in the mean time the latter would have had plenty of time to change front, so that Roberts would have been compelled to make a frontal attack after all.

In view of these considerations Roberts decided to go around Cronje's left flank, and advance over Waterval and Dekiel's Drifts (on the Riet) and Klip Drift (on the Modder) over Olifantsfontein, a maneuver which was both tactically and strategically sound, and promised great results. Tactically, it took the British army over open ground, and gave the relief column a direct and unoccupied route to Kimberley, and strategically it cut Cronje's line of communications with Bloemfontein.

Lord Roberts' plan was to leave Lord Methuen with the Guards brigade at the junction of the Riet and Modder rivers, in order to support the turning movement by a frontal attack on Cronje's position, while he with the cavalry under French, the Highland brigade, the divisions of Kelly-Kenny and Tucker, as well as the new division passed around Cronje's left flank. This involved a division of his forces, and, of course, gave the enemy an opportunity to attack the separated parts in detail, but his superior strength, and the great results promised, warranted his taking the risk.

On the 12th of February French, moving over Enslin, Graspan and Ramdam, crossed the Riet at Waterval's and De Kiel's Drift, and after a march of 37 miles, the Modder at Klip Drift on the

TEMPORARY BRIDGE OVER THE MODDER RIVER.—*Armée et Marine.*

13th. On the 14th he had an action with a Boer force at Roodekalkfontain, and carefully reconnoitring on the way, passed between Olifantsfontain and Alexanderfontein into Kimberley on

the 15th. The siege of Kimberley had lasted 122 days (Oct. 15, 1899, to Feb. 15, 1900). To cover his left flank, a detachment under Colonel Gordon was sent over Rondeval's Drift (west of Klip Drift), which, after some slight engagements with Boer detachments, turned to the left and reconnoitred in rear of Cronje's position.

The 6th division, followed by the Highland brigade, crossed the Riet at Waterval Drift on the 14th, reaching Klip Drift on the 15th. The other two divisions and Roberts' headquarters also crossed the Riet on the 14th, but at Dekiels Drift. A Boer commando of 2000 men under De Wett, coming from Colesberg to reinforce Cronje, advanced from Koffeyfontain (9 miles below Waterval Drift) and captured a large British wagon train. Roberts with his two divisions turned on Jacobsdal, but found it abandoned and the Boers in retreat.

Cronje, it appears, was completely surprised by Roberts' movement, and not until reports of French's fight north of Klip Drift reached him did he have any clear idea of the situation. He promply gave orders to retire from the Magersfontein position and to raise the siege of Kimberley, directing all the troops in this vicinity towards Bloemfontein. The interval between French (at Kimberley) and Kelly-Kenny (still south of the Modder River) enabled him to slip through. On the 15th of February he assembled his troops, and on the 16th commenced his retreat eastward. His plan was first to move along the north shore of the Modder, and cross to the south at Paardeberg Drift. On the 16th Lord Kitchener (who was with the 6th division at Klip Drift) saw at daybreak immense clouds of dust, moving eastward and at once concluded it was Cronje's army in retreat, and decided to pursue, sending the mounted infantry after his train. The British scouts found his rear guard at Roodekalkfontein, and Kelly-Kenny (who had crossed the Modder), hastened after him with Knox's brigade and captured a part of his train. On the 17th French's cavalry division started from Dronfield to the Modder River in pursuit of Cronje. Stephenson's brigade was sent back over Klip Drift, along the southern bank of the Modder River to cut off Cronje's retreat in that direction. The two divisions with Lord Roberts were ordered to move on Boemfontein, French was directed to hang on Cronje's rear, while Lord Methuen was sent up to Kimberley to restore the communications there.

Lord Roberts had in all about 53,000 men, but for his offensive movement only 40,000, Cronje had in all about 35,000 men:

5,000, which were moving from Jacobsdal on the southern road, 8,000, his main army, north of the Modder at Koodoos Rand Drift, 6,000 at Stormberg, and 10,000 from Colesberg, at this time near Koffeyfontein, marching against Roberts' right flank. About 6,000 had retired to the north and north-east.

Cronje reached Driput on the 16th, halted to rest and continued his retreat in the night along the north bank of the Modder to Wolvekraal Drift. He was followed by Knox's brigade, which, joining Stephenson's on the 17th at Klipkraal Drift, continued its advance thence along the south bank, towards Paardeberg Drift.

### Battle of Paardeberg.

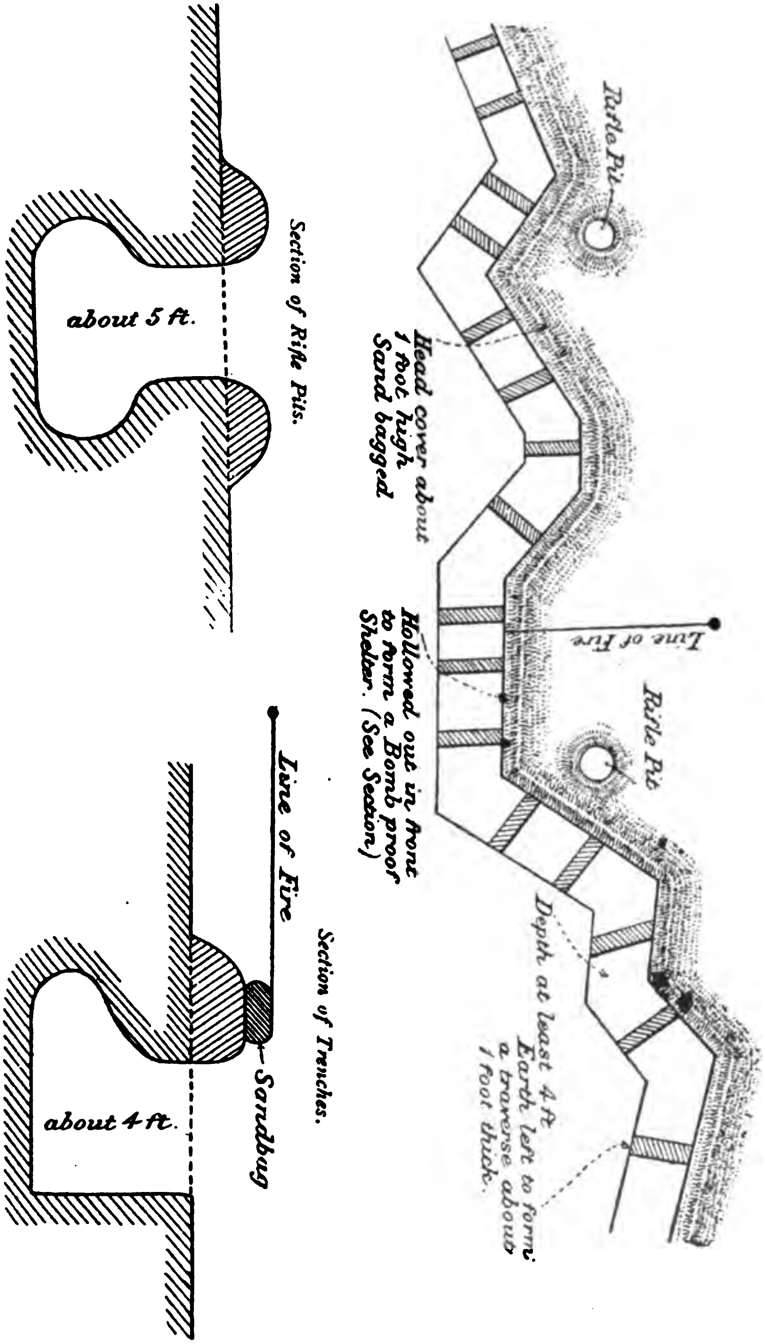
Cronje halted at Wolvekraal Drift (half way between Paardeberg Drift and Koodoes Rand Drift), intending to cross there on the morning of the 18th. On the north side he was already cut off as Broadwood's brigade and a horse battery (from Kimberley) had reached Koodoes Rand Drift on the evening of the 17th and occupied the heights there, and French with his other two brigades struck Cronje's wagon park at noon near Kameelfontein (north of Wolvekraal Drift).

Lord Kitchener, with the 6th division, accidentally passed Paardeberg Drift, and so reached the point (on the south bank) just opposite Cronje's camp (on the north bank). The 9th division (over Weydrai) reached Paardeberg Drift in the night of the 17th, Smith-Dorrien's brigade crossing there to the north bank, while Macdonald's joined the 6th division on the south bank.

The British attacked from the south bank on the 18th, but could not take the Boer positions along the river bank, which had been intrenched during the night. On the 19th the 7th division and the naval brigade arrived. Lord Roberts decided to prepare for any further attacks by artillery fire, and located his artillery, consisting of about 50 guns, to shell the Boer laager, posting three field batteries and two naval 12-pdrs. south of the Modder at 2000 yards from the laager; one howitzer battery and three 4.7-inch naval guns on the north bank, enfilading the river bed, in which was the laager, at 1000 yards range. A concentric fire was thus brought to bear on Cronje's camp, which was kept up for several days, the infantry gradually drawing up closer by trenches thrown up at night.

The balloons did good service in locating vulnerable points not visible to the gunners. On the 24th they located the Boer caissons which were promptly blown up by the artillery.

Several attempts were made by commandos of Boers (under




Boer Trenches at Paardeberg.—*Jour. Royal Unit. Serv. Inst.*

Botha and others from Natal) to break through the British lines, and reinforce Cronje, but they were all repelled with heavy loss. French's cavalry division was intrusted with the duty of warding off these attempts, and took position on both banks, facing east, supported by a part of the 7th division.

Cronje lost about one-fourth of his command during his week of heroic resistance. On the 26th he made a desperate effort to break through but was repulsed, and on the morning of the 27th (the anniversary of Majuba Hill, where Cronje defeated the British) he surrendered.

The forces which capitulated amounted to 4,100 men, with 4 Krupp guns, 2 Maxim guns, and 9 one-pounders. Among the officers who surrendered, besides Cronje and his brilliant chief of artillery, Major Albrecht, there were 10 commandants and 18 cornets.

The fruits of the victory were rapidly reaped in other quarters. Barkly West on the Vaal was occupied by a force detached from Methuen's command at Kimberley, and the country around Kimberley was gradually taken under British control again. Colonel Plumer received reinforcements from Rhodesia, to enable him to attack the Boer position at Crocodile Pools.

General Roberts moved his headquarters to Osfontein, his main army facing eastward, on both banks of the Modder River, while his cavalry under French scouted towards Bloemfontain. The main Boer position was between Abrahamskraal and Aasvogelkop, behind the Kaal Spruit. General Joubert came with the reinforcements from Natal and had the supreme command. The advanced Boer line was held by Lukas Meyer, extending over Petrusberg, Boschkop and Wolvespruit.

### THE SOUTHERN THEATRE OF WAR.

The effect of Cronje's surrender made itself felt at once in the other theatres of operations, in spite of the great distances separating them. The central position of the Boers gave them the advantage of interior lines, and enabled them to transfer quickly troops from one part of the general theatre to another, where they were most needed at the time; but the strategic advance of the Boers was too extended for the forces at their disposal, and they tried to cover too great an extent of country, consequently, when the British gained the superiority in numbers, they could no longer weaken any part to reinforce another temporarily, because the distances were so great that they could not hope to bring such troops back in time to meet a British advance at the depleted point.

About the time that Roberts began his advance, the Boers under Delarey, in the southern theatre, gained some marked successes, forcing the British first from Colesberg, and then from Rensburg, back to Arundel. But just as they were ready to threaten Roberts' line of communications, reinforcements had to be sent to Cronje: De Wett from Colesberg, and others from Dordrecht, Molteno, and Naauwpoort. His entire force was about 10,000 strong, and after leaving 2,000 at Arundel, he rent the rest to threaten Roberts' right flank, and, if possible, reinforce Cronje.

On the 18th of February General Brabant entered Dordrecht, and the British forces advanced to the line Barkly East—Jamestown—Colesberg. Lord Kitchener, after Cronje's surrender, came in person to this portion of the theatre to direct the advance.

On February 27th General Clements reoccupied Rensburg and Colesburg, and on the 28th Colesberg junction, the enemy retreating on Norvals Point.

On the 22nd and 23rd Gatacre reconnoitred towards Stormberg and had a severe skirmish there.

**The Situation in Natal.**

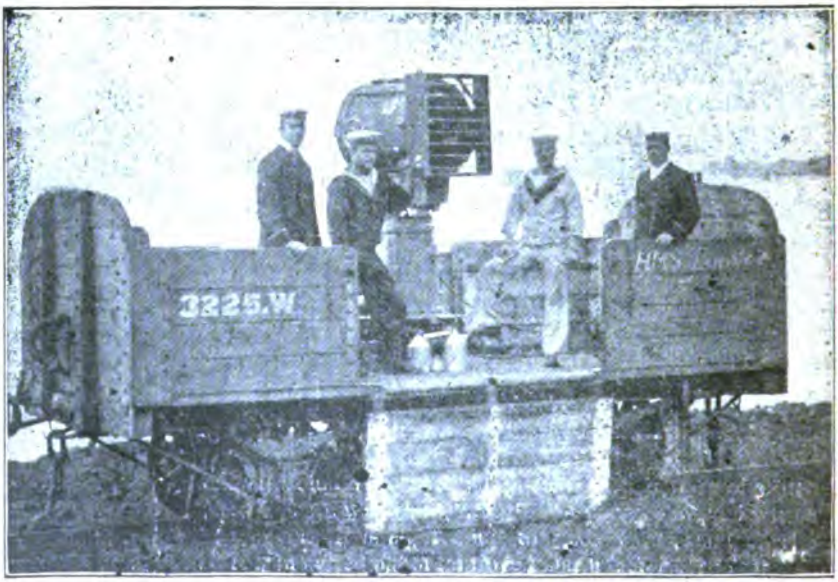
**The fourth attempt to relieve Ladysmith.**

In order to prevent the Boers in Natal from sending reinforcements to the western theatre, and if possible to relieve Ladysmith, Buller began a new offensive movement on the 17th of February. This time his attack was directed on the Hlangwane Berg, east of Colenso, in order to gain possession of the nearer bank before attempting to cross the Tugela. As early as the 12th of February he had made a reconnoissance of Hussar Hill, 6 miles north-east of Chieveley, and finding the Boer lines marked by Colenso, Hlangwane Hill, Green Hill, Monte Christo and Cingolo, he determined to turn the left flank of this position; on the 14th he had directed his troops on Hussar Hill, the irregular cavalry supported by two infantry battalions covering the left flank, Dundonald's cavalry covering the front of advance. The latter had taken Hussar Hill after a slight skirmish at 8 a. m. on the 14th, and by night the British troops were intrenched in the position. The 15th was devoted to artillery fire on the enemy's line.

On the 16th the real advance began. The 2nd division (Lyttleton, who had replaced Clery, the latter being ill) and Wynne's brigade were to march eastward and make a grand turn to the left, while Dundonald's cavalry brigade, crossing the Blaauw-

kranz River, was to pass farther to the eastward and scale the hill of Cingolo; Barton's brigade was to remain with the artillery, and the latter (66 pieces) was to prepare the advance by firing on Green Hill, where the Boers had a heavy gun and two light ones. Hart's brigade was to guard the railroad.

Cingolo was occupied by a Boer outpost only, and was quickly taken by Hildyard's brigade. It became evident in this attack that the Boers were still in force here, consequently, on the 17th, three brigades were ordered to attack the heights: Barton's on the left to demonstrate, Hildyard's on the right, to make the principle attack, the 4th brigade (Norcott's) in reserve on its left rear, Dundonald covering the right. The ascent was very difficult. The troops bivouacked on the ground gained. On the 18th




SEARCH-LIGHT FROM H. M. S. TERRIBLE.

the attack was resumed. The artillery opened at 8 a. m., and Hildyard's brigade (with Norcott's on its left) advanced against Monte Christo, which was taken by 11 a. m. The Boers, being taken in flank, were compelled to evacuate Green Hill and Hlangwane Berg, which were occupied by Barton's brigade, the artillery moving up.

Buller's troops gradually forced the Boers back, and on the 20th the latter evacuated the south bank of the Tugela, and a battalion of Hart's brigade (from Chieveley) occupied Colenso, where they found the bridge destroyed.

**The Battle of Pieters.**

On the 21st of February Buller threw a pontoon bridge over, below Colenso. The British troops crossed the Tugela and attacked Groblers Kloof on the 21st of February, but without much success. The British artillery, posted on Green Hill and the Hlangwane Berg supported the advance. The mounted infantry occupied the hills north of Colenso, and at noon the 5th division crossed the ponton bridge, followed by Hart's brigade, while a battalion of the 10th brigade (Coke's) advanced against Groblers Kloof. The Boers, however, forced back the attack. On the 22nd the struggle was renewed. This time the attack was directed on Pieters Hill, but again without success. The whole of Buller's army was now over the Tugela near Fort Wylie, the

ROAD LOCOMOTIVE.

Boer position in a semi-circle before it. On the 23rd another effort was made to take Pieters Hill, but this also failed. Buller intrenched his infantry, and on the 24th moved with his artillery back over the Tugela, followed by the infantry; he destroyed this pontoon bridge, and in the night threw another pontoon bridge over the Tugela nearer Pieters Station at the mouth of the Langverwacht Spruit. On the morning of the 27th, Barton's brigade crossed the bridge and stormed Pieters Hill. Meanwhile Warren (with the 4th and 11th brigades) attacked the western heights, and Dundonald, with four squadrons of cavalry, moved on to Ladysmith, which he entered on the 28th, thus relieving this city after 120 days investment.

The Boers retired from their positions in the vicinity of the town towards the mountain passes, and Buller moved on Nelthorpe on the 28th. The Boer forces had been greatly weakened by reinforcements sent to the western theatre.

Buller's losses between February 16th and 27th amounted to 1,859: 252 killed, 1,512 wounded and 95 missing.

The total casualties in Ladysmith during its investment were 24 officers and 235 men killed, 70 officers 520 men wounded, 6 officers and 340 men died of disease.

On February 27th Hart was placed in command of the 2nd Division, Clery having been injured; Colonel Kitchener (brother of Lord Kitchener) received the 11th Brigade, Wynne having been wounded; and Colonel Norcott the 5th Brigade in place of Hart, promoted.

Buller moved his troops up to Nelthorpe on the 28th of February.

COMMENTS.

In this campaign the great principles of strategy and tactics appeared in some cases to be violated at the outset, but closer inspection and further developments invariably showed the fallacy of such a conclusion. One of these great principles is the old-established maxim that, in spite of all the boasted defensive power of modern intrenchments and the immensely increased effect of modern fire-arms, only the *offensive* (strategical and tactical) can lead to *decisive* results.

With the British the spirit of the strategical and tactical offensive was innate, and the reason it did not make itself felt in the earlier stages of the campaign was due to several causes. In the first place their entire system, both as regards organization and practical field training, was somewhat imperfect. Their field maneuvers were inadequate to teach practically either the proper tactical employment of the separate arms, or that of the three arms combined, to impart a knowledge of correct estimation of their own or the enemy's fire-effect, or to impress the troop leaders with the necessity for flank attacks in proper form in modern battle tactics.

This accounts for the fact that the offensive of the British was *strategically* unsound, in that the forces were too much subdivided, too greatly scattered, and not applied with the best effect; and in that the enemy was greatly underrated and the general situation very imperfectly known. Moreover, *tactically* the execution was poor, in spite of great bravery on the part of officers and men, on account of antequated battle formations and tactics.

The service of reconnoissance and the mobility of the troops were no doubt affected by the climate and the terrain, and the difficulties of the former were greatly increased by the character of the ground, the lack of good maps, the use of smokeless pow-

der and the manner of fighting of the Boers, and these causes also interfered with the best use of the artillery, nevertheless, as will appear later, the first well planned and prepared offensive advance (that of General Roberts), executed with rapidity and energy, promptly compelled the Boers to give up their fastness at Magersfontain, so that it was evidently previous mistakes in strategy and tactics that caused the failure of so many efforts, not the climate or the terrain, much as they may have increased the difficulties.

The Boers, on the other hand, in spite of their original offensive advance with its brilliant results, do not really possess the spirit of the offensive strategically, and are not capable of executing the offensive tactically, as shown by the subsequent events. On a small scale there were, on the part of the Boers, occasional offensive attacks and pursuits, as in some of the actions in Cape Colony, but never with large bodies of troops. For cohesive attack they lack the necessary leaders, training, discipline and tactical organization, and for energetic and prompt pursuit they lack cavalry, for although every Boer is mounted, he is not in a true sense a cavalryman.

### The Defensive and the Offensive.

At first sight it would appear that the plainest lesson taught by the Boer war is the apparent impossibility of attacking successfully in front a fortified position, in other words, the impossibility of so silencing even a weak artillery on the defensive, and so demoralizing a good infantry line on the defensive, as to enable the attacking infantry, without too great loss, to move to the attack over open ground.

Both at Magersfontain and at Colenso the English artillery was superior to that of the Boers, and especially was this the case in the later actions on the Upper Tugela and on the Vaal Krantz. In all these cases the British artillery could not dominate that of the Boers, and in the first two actions referred to, the British greatly overrated the effect of their artillery. At the last mentioned action the infantry advance was indeed prevented by the Boer artillery alone.

Many authorities conclude, therefore, that our ideas on this point of tactics must be modified accordingly. It is at present stated in all tactics that the first duty of the attacking army is to silence by means of its artillery that of the enemy; then to concentrate its artillery fire on the enemy's infantry at the point of principal attack. But from the above it appears that the artillery of the defense may withdraw temporarily (be apparently silenced)

and then turn up in full power at the moment of the decisive infantry attack. But these conclusions must not be arrived at hastily. There are many considerations that must first be settled before we can determine whether the English artillery actually followed modern tactics in its employment of this arm. It appears, on the contrary, that the batteries were brought into action separately, and seldom really attained concerted fire-action on the decisive point of attack, moreover, they had at first no pieces for curved fire (recognized everywhere as essential nowadays in the attack on intrenchments), and finally, the difficulties of the ground were such as to exclude anything approaching ideal action as a general rule. Consequently, it is better to wait till more complete data are available, before laying too great stress on the power and advantages of the defensive.

In fact, if there is one lesson that does stand out prominently and definitely, throughout the Boer war, it is the necessity for adopting the offensive in order to secure decisive results. In other words, the exact opposite of the conclusion above suggested, which would give the preference to the defensive.

The indecisive results even of the Boer victories can only be attributed to their lack of offensive power, either in attacking the British in intrenched positions (as at Ladysmith), or, after defeating the British attack (as at Dundee, Colenso and Magersfontein), in taking up a proper offensive counter-attack, thereby making their victory complete. An active and energetic offensive at Ladysmith and on the Tugela, would have led to results very different from the passive defensive actually adopted, and the Boers could have met the advance of Roberts with very different forces from those which they were actually enabled to assemble. Moreover, a more energetic offensive south of the Orange River would have made it possible to penetrate farther into the British domain, and would have afforded a better chance of encouraging the Dutch inhabitants to rise and join their Boer countrymen.

The old principle of strategy, therefore, still holds true, viz: that the best mode of action for decisive results is the strategical and tactical offensive. The resorting to mere frontal attacks and the remaining on the tactical defensive and indulging in mere position actions are signs of mediocre ability. If the enemy adopts the tactical defensive the advantages of his mode of action must be overcome by proper strategetic deployment and advance and by increased mobility, to force him from his positions, to obtain the superiority in numbers, not at all points of

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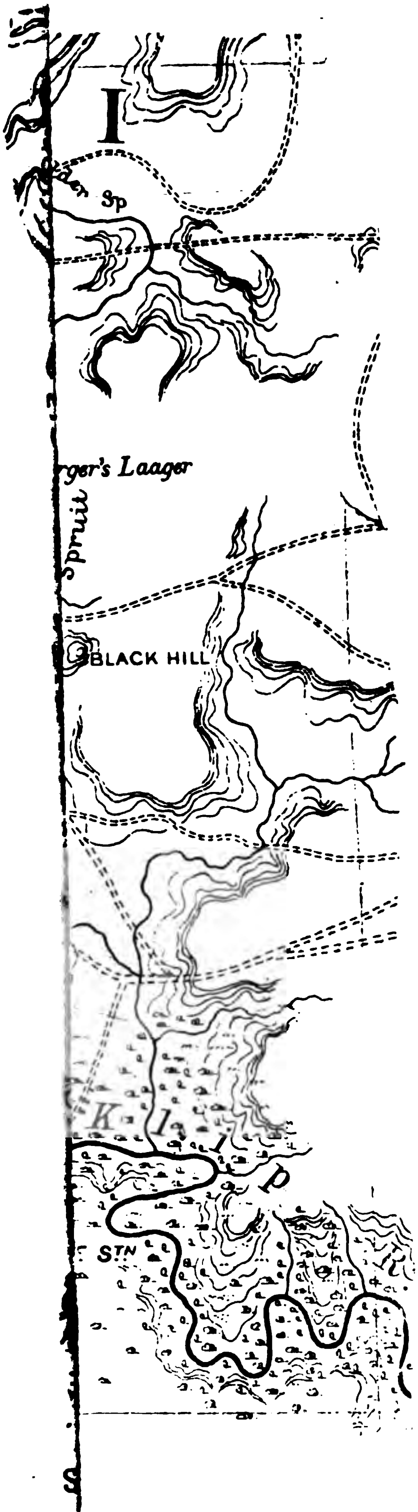
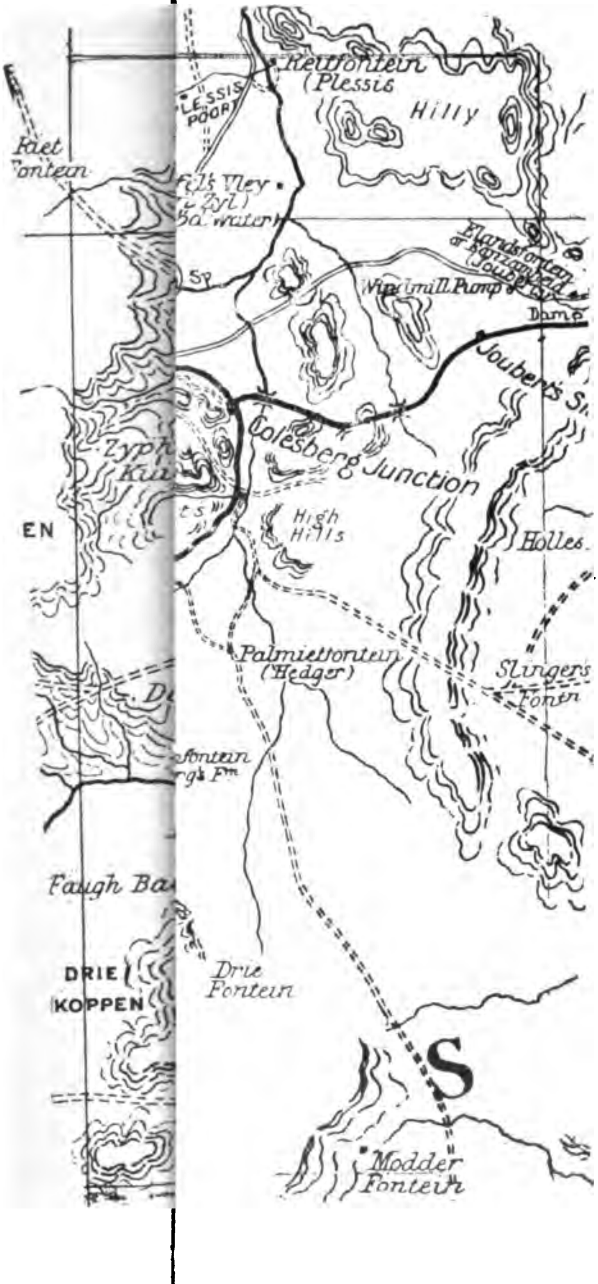




Reitfontein
(Plessis
Hilly
PLESSIS
POORT
Kaet
Fontein
Elandsfontein
Windmill Pump
Dam
Joubert's
Colesberg Junction
High
Hills
EN
Holles
Palmietfontein
(Hedger)
Slingers
Fontein
Faugh Ba
DRIE
KOPPEN
Drie
Fontein
S
Modder
Fontein


15 Miles

the line, but at the decisive points, and to keep him moving, thus preventing him from occupying continually strong positions. All this requires a well-trained cavalry for reconnoissance, an artillery with proper material as well as one trained in the correct tactical emplyment of this arm and in hitting, and finally an infantry instructed to shoot accurately and move rapidly.

### Railways.

One of the characteristic features of modern warfare is the part played by railroads. The power of effecting rapid concentration which they confer causes their direction and location to determine the lines of advance of the main armies, and their points of crossing or branching fix the strategical points in the theatre of war where the great battles must be fought. The side that possesses or commands the main lines at the opening of a campaign has an immense advantage, and this advantage in the present war was with the Boers.

Pretoria, the Transvaal Capital, has radiating from it three main lines: one to Lorenzo-Marques, one to Durban, and one to Port Elizabeth; the latter with a branch from north of the Orange River to East London; a fourth main line runs west of the two Republics from Buluwayo to Cape Town. There are also two minor lines, one from Prestoria northward to Pietersburg, and one from Johannesberg south-westward to Klerksdorp.

The Boers, of course, made full use of these lines in their strategic deployment on the border, and in their subsequent advance, but the original disposition of their troops resulted mainly from the British forces at Dundee, Ladysmith, Mafeking and Kimberley, hence they concentrated the bulk of their armies on the Natal and the western frontier, neglecting the important points on the Orange River border. Had the British been able to conduct their campaign on purely military principles, untrammeled by political reasons for relieving these isolated points (Ladysmith, Kimberley and Mafeking), this neglect might have been at once fatal to the Boer strategy, for the military plan was, it is stated, to advance from the south directly on Boemfontein and Pretoria over the Orange River.

The holding on to the isolated points above mentioned, had the same crippling effect on the Boers, therefore, that it had on the British movements, for it prevented the former also from carrying out their original plan of invading Cape Colony, concentrating in Natal at Pietermaritzburg, and forcing the point of main attack in the west far south of Kimberley. Had they

carried out this plan the problem for the British would have been a far more difficult one.

### The Strategy of Buller's Campaign.

General Buller's plan to turn the Boer right flank over the Upper Tugela is based on a correct strategical principle, but its success must depend on the forces available, for this was not a mere tactical maneuver, but a strategic operation on a large scale, involving an extension of the British base from Frere over Springfield to Trichard's Drift, about 20 miles, before the actual turning maneuver can begin.

The Boer position was, moreover, naturally very strong and was occupied in force. Ultimate success in the turning movement depended on the rapidity of its execution, and this, in the face of all the difficulties of the situation, was practically impossible.

However, the left flank was the critical point of the British line, and there, north of Tritchard's was Buller's place, and not at Spearman's camp. The tactical value of that part of the Spion Kop which was the object of the attack was greatly overrated, on account of imperfect reconnoissance and poor maps, and, had Buller been originally with Warren's force he probably would not have permitted the assault on this point.

The Boers, after Warren's failure, again neglected a splendid opportunity to reap the rewards of success in not pursuing. Even admitting that they were economizing their men, it is plain that an energetic pursuit might have almost annihilated Warren's command, in which case the Boers would have been spared the battles of the 5th and 7th of February, which also involved considerable losses to them. As it was, Buller's plan failed, but his strength was not broken, and he immediately proceeded to make and execute other plans for breaking through the Boer lines.

### The Tactics of Buller's Campaign.

General Buller's third attempt to relieve Ladysmith was justified by the circumstances, for it promised success, and even if it failed it held a certain number of Boers in Natal and therefore away from Roberts' front. Nevertheless, there are several points in the plan and its execution which are subject to criticism.

Once more imperfect reconnoissance led to overrating the tactical value of the Vaal Kranz, and consequently it was not known until after it was taken that it could not be held.

The two key points to the Boer position on the upper Tugela were the Spion Kop and the Doornkloof, and yet in the two separate attacks on these points Buller did not put in *all* his

available forces, nor did he act with the requisite energy in pushing the attack. In both cases the Boers were at first surprised, but the inadequacy of the forces employed prevented a rapid advance and gave them time to reorganize their lines, and repel the attack.

Buller's attack, moreover, does not appear to have been supported in the least by any demonstration on the part of Barton in front of Colenso.

This appears to have been the fault with all of Buller's battles. When he attacked the key point of a position he made no general attack along the entire line to prevent the enemy from reinforcing the threatened point, in fact, he allowed them every opportunity to do so at their leisure—at Spion Kop, at the Vaal Kranz, at Pieters Hill. An energetic attack along the entire line would have prevented that constant shifting of forces by the Boers, which enabled them to make such good use of their small force, and their interior lines.

The Boers took no measures to reap the rewards of their victory. They neither pursued Buller's army over the Tugela, nor made any effort to defeat Barton and so cut off Buller's line of retreat.

### The Strategy and Tactics of Roberts' Campaign.

General Roberts could have divided the reinforcements he received in the 6th and 7th division, but it would have been another case of splitting up the forces, so he decided to add them all to the left column.

The new troops amounted to 30,000 men and 9 batteries. Had one division only been added to Lord Methuen's army he would have had 25,600 men and 78 guns; and had the other division been assigned to French's command, and Gatacre's also added, this column would have had 24,000 men and 60 guns; Brabant's division would have been available to reinforce either column. The total of the British field forces in this theatre would have been about 60,000 men and 138 guns.

The Boers had about 20,000 at Magersfontain, 15,000 at Colesberg, and 6,000 at Stormberg, or a total of 41,000.

Evidently, Roberts could have advanced on both lines, but by combining all his reinforcements on one the results were more decisive and also more rapid.

General Buller on the Tugela was compelled to inaction. It was very difficult for Roberts to leave this army of 30,000 men and 78 guns inactive, but had Ladysmith fallen, the besiegers, 20,000 in number, would have been at once available in other

theatres and the British would have lost the chance of having the garrison of 8000 added to their ranks in case of a successful sortie. Therefore, there was nothing else to do but let Buller detain as many of the enemy as possible in his front.

The results of Lord Roberts' victory stand out in marked contrast with the early successes of the Boers on the Modder, at Colenso and at Stormberg: whereas the latter were isolated successes, with no decisive effect on the general situation, the former entailed the retreat of the Boers along their entire line of defense as far east as Natal. The cause is not far to seek, and illustrates on the one hand the weakness of the purely *defensive,* and on the other the power of the strategical and tactic *offensive* combined with a definite plan of action.

#### The Strategy and Tactics of the Boers.

The strategic deployment of the Boers and their advance over such widely separated lines (Natal, Cape Colony and the West) was in accordance with sound principles of strategy. The advance into Natal was demanded because of the presence there of the main British force and the shortness of their line of communications; that into Cape Colony and the West was necessitated by the immense importance of gaining possession of the railroad net-work, which was so essential for the rapid advance of the British, and also the desire to gain reinforcements from the Afrikander population in these districts. Nevertheless, the three lines should have been treated differently in a tactical sense, for, while a tactical, as well as strategical, offensive was quite in place in Natal, the southern and western theatres warrented (and in view of the limited Boer forced, commanded) the tactical defensive, provided the strategic measures were sufficient. But the latter was hardly the case, for, the Boer efforts against the line DeAar—Kimberley were not on a scale corresponding to its vast importance to the British. In the early stages of the campaign this line was occupied by such weak British forces that it would have been very easy to have destroyed considerable stretches of it, moreover, even in the later stages there were many points vulnerable to such attacks. An effective destruction of this road, requiring considerable time to repair, might have fatally delayed Roberts' advance, or caused him to alter his plan. In addition, constant attempts to interfere with this all-important line would have revealed to the Boers the plan of the British, and probably prevented Cronje's surprise.

However, the fact that in general the tactical defensive was the proper rôle for the Boer troops in the west, should not have pre-

vented them from taking up the tactical offensive after the defeats of Lord Methuen on the Modder river. Such an offensive after the battle of Magersfontain, when Lord Methuen still had the river in his rear, promised decisive results, and his further defeat would have prevented Lord Roberts from assembling his army in Cronje's immediate front, and would consequently have prevented him from surprising Cronje by his flank movement.

The great weakness of the Boers, however, was the lack of the tactical offensive in Natal, where it was more particulary in place. This lack of the tactical offensive neutralized all the advantages of their strategical offensive advance, and enabled the British to transfer the decisive theatre to the west. Had the Boers followed up their strategic deployment and advance in Natal with an energetic tactical offensive, the British would have been forced to accept Natal as the decisive theatre, and all the advantage of topography and situation of the troops would have been with the Boers; or, in case the Boers won a decisive victory there, sufficient Boer forces might have been liberated to turn the tide in the west.

This tendency of the Boers to avoid the tactical offensive is apparent even in the selection of their defensive positions, which rarely admit of easy advance toward the front, and is further emphasized by their neglect of proper pursuit after victory.

The offensive requires a far higher capacity in the troop leaders than the defensive, and the Boer commanders were evidently not sufficiently trained in the art of war to meet these requirements. The defensive may be the stronger form, but the offensive is nevertheless the most effective. So long as the Boer defensive remained intact at all points of their line it succeeded, but the moment the British offensive broke that line at a single point the entire line was broken.

### The Artillery Tactics of the Boers.

It is a principle, definitely established long before, but specially emphasized by the experiences of the Franco-Prussian war, that artillery fire, to be effective, must be concentrated.

The Boers seem at first sight to have upset this principle. They were able to select their ground, conceal their guns, and prepare their positions, and this, combined with the use of smokeless powder, which assisted the concealment, and the longer range of their guns, gave them such an advantage that military men began to think that isolated guns in well-concealed positions was better than masses of artillery. But, in reality, the old principle is still true, and it is only a question of modifying the application.

The Boers, although adepts in hiding their artillery never succeeded in concentrating its fire, and this is one of the secrets of their want of success.

# APPENDIX.

## ADDITIONAL COLONIAL CONTINGENTS.

### Canada.

1,247 men.
4 Squadrons Mounted Infantry.
3 Field Batteries.

### Australia.

Infantry.. 1,250 men,
1 Field Battery.

### New Zealand.

200 men, 4 Hotchkiss guns.

### India.

250 mounted men.

### Ceylon.

125 mounted men.

## ADDITIONAL TROOPS ORDERED.

The *8th Division* sailed from England in the latter part of March, and arrived at Port Elizabeth and East London about the middle of April.

The 1st battalion Leinster regiment came from Halifax, Nova Scotia, to England to be mobilized and did not embark there for South Africa till April 18th. The three batteries first assigned to the division were left behind, but after the loss of 7 guns at Koorn-Spruit (March 31, 1900) two other batteries for this division were ordered mobilized at Aldershot.

Of the *Militia* 29 battalions have been (up to the end of April) sent to South Africa, 4 to Malta, 1 to Cairo and 1 to St. Helena (to replace other troops and, at the last-mentioned place, to guard prisoners).

Of the *Imperial Yeomanry* 79 companies were organized into 20 battalions, besides a battalion of Sharpshooters, one of Rough Riders, and one called Paget's Corps. They began to arrive in South Africa on the 9th of February, and on the 21st of April there were 58 companies in South Africa, 12 at sea, and 9 still at home.

## TROOPS IN SOUTH AFRICA.

At the opening of Lord Roberts' campaign, about the middle of February, England had the following troops in South Africa:

| | | | | |
|---|---|---|---|---|
| Army of operations at the front | 110,000 | men, | 216 | guns. |
| In Ladysmith | 8,000 | " | 46 | " |
| In Kimberley | 2,600 | " | 76 | " |
| In Mafeking | 1,000 | " | 16 | " |
| Reserves, and on Line of Communications: | | | | |
| In Natal | 4,000 | " | } 32 | " |
| In the Center and West | 8,500 | " | | |
| In Cape Town | 5,500 | " | | |
| In Rhodesia | 2,000 | " | 6 | " |
| Non-combatants | 22,400 | " | | |
| Losses in killed, wounded and prisn'rs. | 10,000 | " | | |
| Sick | 5,000 | " | | |
| Total in South Africa | 179,000 | " | 392 | " |

On the way to Cape Town ........................ 17,150 men, 172 guns.
Embarked : 4th Cavalry Brigade.
Mobilizing........................................................ 17,150 " 24 "
Ordered mibilized : 9th Division.

The Boers had about ............................................ 65,000 " 110 "

Up to the end of February the total number of troops sent from England amounted to 141,165 men, 24,103 horses and 379 guns.

TOTAL BRITISH FORCES IN SOUTH AFRICA, INCLUDING COLONIALS.

| | *Unmounted.* (includ. artillery) | *Mounted.* | *Total.* |
|---|---|---|---|
| February 15,* | 15,142,800 | 37,800 | 180,600 |

BOER LOSSES.

Up to the middle of January.

| | | | |
|---|---|---|---|
| Mafeking, | 500. | Against Gen. French, | 300. |
| Belmont, | 400. | Against Gen. Gatacre, | 100. |
| Graspan, | 250. | Glencoe, | 300. |
| Modder River, | 400. | Elandslaagte, | 600. |
| Magersfontein, | 700. | Ladysmith, | 2,000. |
| Kuruman, | 100. | Sundry, | 400. |
| Douglas, | 75. | | |
| | | Total, | 6,425. |

TOTAL BRITISH CASUALTIES (OFFICIAL).

Up to February 24th.

| | | | | | | |
|---|---|---|---|---|---|---|
| | 161 | officers | and | 1,490 | men | killed. |
| | 194 | " | " | 5,795 | " | wounded. |
| | 133 | " | " | 2,669 | " | prisoners and missing. |
| Total, | 488 | " | " | 9,954 | " | |

CHANGES IN COMMAND.

Feb. 10. General Colville to command 9th Division, newly formed.
Feb. 10. Colonel Douglas to command 9th Brigade, *vice* Colville, promoted.
Feb. 27. General Hart to 2nd Division, *vice* Clery, injured.
Feb. 27. Colonel Norcott to 5th Brigade, *vice* Hart, promoted.
Feb. 27. Colonel Kitchener to 11th Brigade, *vice* Wynne, wounded.

THE NAVAL BRIGADE.

The *Terrible* arrived at Simons Bay on October 14th, and while getting ready to land the small arms and field guns, the captain (Percy Scott) concluded that heavier guns would be needed at the front, and therefore commenced to mount the navy guns on carriages for field use and on platforms, carrying on the work first on board and then in the dockyard. The *Powerful* arrived on the same day and took up the same work. On the 26th the latter was ordered to Durban, and on the day of arrival Captain Lambton took to Ladysmith two 4.7-in. guns, three long 12-pounders and one short 12-pounder, some Maxims, 300 rounds per gun, and 286 officers and men. On November 2nd the *Terrible* received orders for Durban, arriving November 6th, and at once landed the heavy guns :

* Not including 8th Division or 4th Cavalry Brigade.

One 4.7-inch Q.F., on wheeled mounting.
16 long 12-pounders, on special mountings.
2 short 12-pounders, on field mountings.
2 Maxims, on field mountings.
300 rounds for each piece.

21 officers and 250 men were also landed, all for the defense of Durban.

Four 12-pounders were soon taken to Pietermaritzburg, to replace two long 12-pounders which had been landed by the *Powerful*, these having been ordered forward to the Mooi River.

On November 23rd two more were sent from Durban, the four previously sent having also been sent forward to Mooi River and Estcourt. The guns sent forward were manned by men of the *Tartar*, *Philomel* and *Forte*. On November 26th two 4.7-inch guns and four more 12-pounders were ordered forward, manned by the *Terrible*.

On December 1st Capt. Scott (*Terrible*) mounted a search-light on a railway car. On December 8th eight more guns were ordered to the front. The two 4.7-inch and 6 of the 12-pounders were in action at Chievely on December 12.

### THE NATIVE VOLUNTEER BODIES.

Bethune's Mounted Infantry.
Border Horse.
Brabant's Horse.
British South Africa Police.
Cape Garrison Artillery.
Cape Medical Staff Corps.
Cape Mounted Rifles.
Cape Town Highlanders.
Cape Town City Volunteers.
Duke of Edinburgh's Own Rifle Vols.
French's Scouts.
Frontier Mounted Rifles.
Imperial Light Horse.
Imperial Light Infantry.
Kaffrarian Rifles.
Kaffrarian Mounted Infantry.
Kitchener's Horse.
Montmorency's Scouts.
Prince Alfred's Own Cape Artillery.
Prince Alfred's Volunteer Guard.
Protectorate Regiment.
Queenstown Rifle Volunteers.
Rhodesia Regiment.
Rimington Imperial Guides.
Roberts' Horse.
South African Light Horse
Thornycroft's Mounted Infantry.

### COLONIAL CONTINGENTS.

#### Australia.

New South Wales Lancers.
1st Australian Horse.
Mounted Rifles.
A Battery.
Queensland Mounted Infantry.
South Australian Infantry.
Tasmanian Contingent.
Victorian Contingent.
Mounted Infantry.
West Australian Contingent.
New Zealand Mounted Rifles.

#### Canada.

1st and 2nd battalion Canadian Mounted Rifles.
2nd battalion Royal Canadian Regiment of Infantry.
C, D and E batteries Royal Canadian Artillery.

#### Ceylon.

Ceylon Contingent.

## THE ARTILLERY MATERIAL.

### BRITISH ARTILLERY.

Strength and Distribution, February 15, 1900.

*Field Guns.*

| | |
|---|---|
| Roberts' Army | 156 |
| Buller's Army | 60 |
| Gatacre's Army | 18 |
| At Arundel and Naauport | 26 |
| Cities and lines of communication | 100 |
| | 360 |

*Field Howitzers.*

| | |
|---|---|
| Methuen's corps | 12 |
| Buller's army | 6 |
| | 18 |

*Navy Guns.*

| | |
|---|---|
| Buller's army | 12 |
| In Ladysmith | 8 |
| Roberts' army | 12 |
| Elsewhere | 26 |
| | 58 |

March 15, 1900.

| | | |
|---|---|---|
| Additional: | Field guns | 72 |
| | Field howitzers | 18 |
| | 4.7-inch Armstrong guns | 6 |
| Mobilizing: | Field guns | 24 |

*The Field Gun.*

The field gun is called a 15-pounder, M. 95; it is of 3-inch caliber, firing only shrapnel (besides canister), initial velocity 1,574 feet, weight 14 pounds; maximum range (15° elevation) 5,468 yards, but can fire 2,000 yards farther. Its mean dispersion (double the mean deviation) in range at 5,468 yards (for percussion shell) is 155 yards, while that of the German gun is only 54 yards. It is sighted up to 5,500 yards, but the shrapnel is timed only to 4,000 yards. It was not originally a quick-firer, but with the Clarke brake it is now practically such.

The City of London Volunteers were supplied with a battery of 3-inch Vickers guns. These guns are wire guns, firing a 12.5 pound shrapnel with a muzzle velocity of 1,575 feet. It is sighted up to 5,000 yards, and carries shrapnel and shell. It is mounted on an improved Darmancier carriage.

The City of Elswick Volunteers were supplied with a battery of 3-inch quick-firing Armstrong guns.

*The Horse Artillery Gun.*

The horse artillery gun is a wire gun of 3-inch caliber, 12-pounder.

*The Mountain Gun.*

A 7-pounder muzzle-loader.

*The Field Howitzer.*

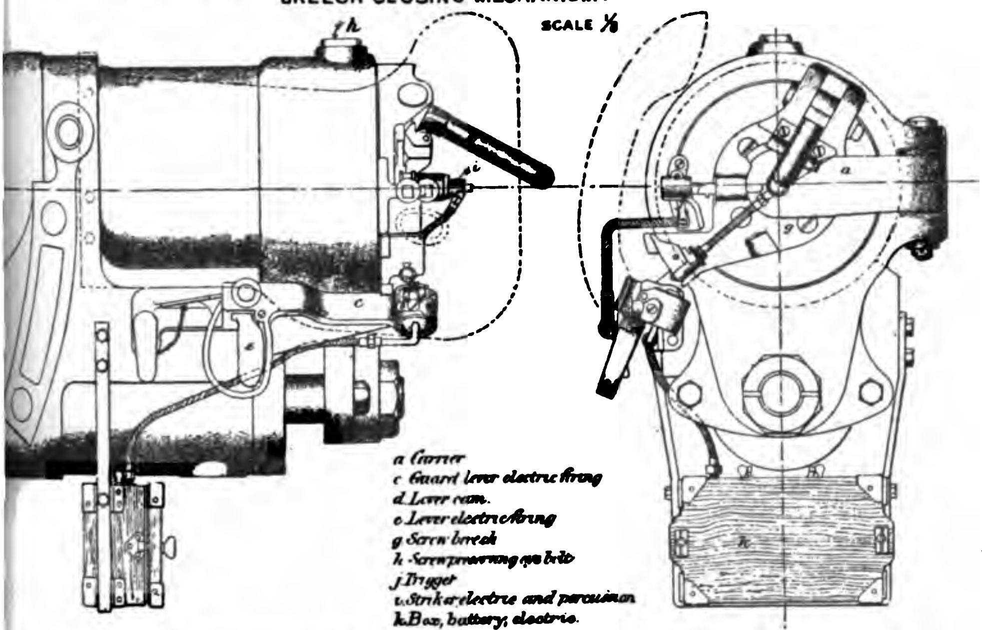
The field howitzer is 5-inch caliber, firing lyddite shrapnel weighing 50 pounds, with time fuze graduated to 3,390 yards, maximum range 4,900 yards. The guns of the siege train sent over from England on December 9th comprised mainly 6-inch, but partly also 4.7-inch and 4-inch howitzers, firing lyddite and other shell.

*Navy Guns.*

These are 6-inch, 4.7-inch and 3-inch.

The 4.7-inch navy guns with Methuen's column were mounted on 40-pounder carriages.

**ORDNANCE. QUICK-FIRING. 4·7 INCH. MARK I, II & III.**
**BREECH CLOSING MECHANISM.**




Those at Ladysmith on 6-inch howitzer carriages, the recoil gear for fixed platform removed.

This gun fires a 50-pound shell, with a muzzle velocity of 1,750 foot-seconds, and great range.

*The Machine Gun.*

Maxim gun firing small-arm ammunition.

BOER ARTILLERY.

44 quick-fire modern field guns, 7.5 cm. or 3-inch. (Krupp, Schneider-Creusot and Maxim-Nordenfeld).

These guns fire (besides canister) shell and shrapnel, with from 1,475 to 1,510 feet muzzle velocity.

6 older 7.85 cm. (3.1-inch) guns.
4 old 6 cm. (2.4-inch) guns.
4 new 3.7 cm. (1.46-inch) Krupp mountain guns.
24 3.7 cm. (1.46-inch) Maxim-Nordenfeld.
50 Maxim machine guns firing either the ammunition of the old Henry-Martini gun, or that of the Mauser gun.
8 12 cm. (4.7-inch) field howitzers (Krupp or Schneider-Creusot). These fire shell, shrapnel and torpedo shell, and are much more mobile than the British howitzers.
6 long Creusot or Krupp 15.5 cm. (6-inch) siege guns (including the

*Long Tom* at Ladysmith), firing an·88 pound projectile with a muzzle velocity of 1,574 feet.

The British cannot *utilize* the maximum range of their field guns (about 7,500 yards), because their sight is not graduated beyond 5,500 yards, and their tables are not worked out beyond this range; whereas the Boers, by burying the trail and by firing as they generally do from above downward, can attain the extreme range of 7,500 yards.

Moreover, the Boer (Krupp) fuse is graduated to 4,200 meters (or 550 meters farther than the British), so that they can fire with shrapnel farther than the British. The British have, however, fired their shrapnel (on account of the great range of the Mauser rifle) at too great ranges,—ranges over 3,600 meters,—where the shrapnel bullets have too low a velocity to be effective. Hence, the great advantage of the Boers in possessing also *shell*, in addition to shrapnel, by means of which they can fire effectively at ranges beyond the maximum effective range of the British shrapnel. The British have nothing in the way of a *field* piece to oppose to the Boer shell fire of over 5,000 meters, or even over 4,000 yards (the limit of the British time fuse).

The Boers have no real idea of tactics in their use of artillery, for we never hear of batteries in the various engagements that have taken place, but always of single guns, and after the second Upper Tugela fight a single gun only pursued the British.

The British, having only shrapnel, were practically without any effect on the Boer infantry in its S-shaped trenches, even when they had a flank fire on them. Such trenches could only be reached by high angle fire, but the maximum range of the British field howitzer is only 4,900 yards, and good ranging with this piece requires well-trained cannoneers, especially when the enemy is as expert in masking its trenches as the Boers were. Moreover, the British artillery lacked tactical handling, in that the superior artillery officers were generally detached, and the work was left mainly to the battery commanders: there was no concentration of *groups* of batteries, no fire control of the entire artillery, indeed, the great lesson of the war of 1870-71, the use of *masses* of artillery, seems to have been forgotten. In an attack the artillery preceded the infantry, but did not always accompany it in its advance, so that the latter really met unshaken infantry in the assault. There is no question of the excellent and fearless handling of the separate batteries in advance or in covering a retreat, but no great tactical result has been accomplished by a large mass of artillery on any of the fields, although the two groups in the battles of the 5th to the 8th of February seem to have worked in unison, and in surrounding Cronje Roberts undoubtedly attained an artillery mass fire.

CAPTAIN JOHN P. WISSER, 7th Artillery.

(To be continued.)

# NEW FORMULAS FOR CURVED FIRE.

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I.

The general equations of motion of a projectile in air (under the hypothesis of a direct resistance) are deduced from the expressions for the horizontal components of the energy and from that of the centrifugal force, both being combined with the known relation $dy = \tan\theta\, dx$. We thus obtain the three following equations:

$$(1) \qquad gd(v\cos\theta = \frac{i\delta_y}{C} v\,F(v)\,d\theta,$$

$$(2) \qquad gdx = -v^2 d\theta,$$

$$(3) \qquad gdy = v^2\cos^2\theta \tan\theta\, d\tan\theta,$$

in which $v$ is the velocity and $\theta$ the inclination of the trajectory at the point whose coordinates are $x, y$; $F(v)$ a function of the velocity (the resisting function above) independent of the density of the medium, of the form, dimensions, and weight of the projectile; $\delta_y$ the density of the air at the altitude $y$; $i$ a coefficient of form; and C the ballistic coefficient $\frac{P}{1000\,a^2}$ for a projectile of weight P in kilograms and caliber $a$ in meters.

In order to integrate this system of equations we must be able to integrate equation (1) and express the variables $v$ and $\theta$ as functions of each other; then, by means of the other two equations deduce $x$ and $y$ as functions either of $v$ or $\theta$. But those who have devoted any time to Ballistics know that the integration of (1) is possible in two particular cases only, already pointed out by D'Alembert at the end of 1744, and that the factor $\delta_y$ largely diminishes the above possibility. To avoid this last difficulty authors of Ballistics regard it convenient to assume the medium as homogeneous, i.e., $\delta_y$ as constant. or they conceive this quantity, under the form of a mean value, as placed outside of the sign of integration. This could then be calculated by itself by the aid of empirical formulas.

With this special artifice relative to the variable quantity $\delta_y$ equation (1) can be easily integrated in the particular cases in which the resistance function $F(v)$ can be put under the form $a + bv^n$, $a$, $b$ and $n$ being any constants whatever. Now from numerous experiments made with modern artillery up to the

present time, we conclude that the function F $(v)$, where $v$ does not exceed 240 m., may, with great approximation, be assumed to vary as the square of the velocity, and therefore, (leaving $\delta y$ out of consideration) the integration of equation (1) in this particular case would no longer present any difficulties. Although equation (1) can thus be integrated under the above hypothesis, still we cannot say that every difficulty has been practically overcome, because the substitution in the other two equations gives us a quadratic which cannot be expressed in finite terms with the elementary functions.

Other very ingineous methods were afterwards invented by various authors, but all those that know anything about Ballistics can not ignore the integration factor $\alpha$ of Didion and the function $\beta$ of Siacci, which are so important in the integration of the differential equations of motion; but the numerical determination of these quantities still leave much to be desired, where it is considered necessary (in order to take into more accurate account the variations of the parameter of a trajectory) to have recourse to the calculation of the same trajectory by dividing it up into arcs.

In our studies we have often had to calculate these trajectories, and always doubts have arisen that the errors, accumulating in passing from the approximated elements at the extremity of one arc to the calculation of those at the extremity of the next arc and thus to the end of the trajectory, might seriously affect the precision of the final results. We believe therefore, that it can be asserted that the ballistic problem still leaves a large field for research; and whether the employment of higher transcendentals might enable Greenhill to effect the integration of the differential equations of motion in the case of F $(v)$ proportional to the cube of the velocity, as the simple use of the elementary functions may permit the above integration when F $(v)$ is proportional to the velocity, still it can not be said (the admitted conditions being too much at variance with the truth) that the ballistic problem has been completely solved by anyone except in some particular case.

Matters being thus we have proposed to attempt once more the solution of the ballistic problem in the most important case of fire with a velocity not to exceed 240 m. This comprises almost all firing with howitzers and mortars, which constitute a large part of modern artillery.

The formulas which we have deduced are not (we hasten to say) of such easy application as will permit their general use in

all practical fire problems, nevertheless we do not believe them without interest, seeing that they may be usefully employed as a means of comparison, in establishing the degree of precision which may be expected from the employment of the formulas now in use.

## II.

The first difficulty to overcome, as we have previously observed, is due to the presence in (1) of the variable $\delta_y$ which, according to an empirical expression of Saint Robert, can be put under the form $\delta_y = \delta_o (1 + a y)$, $\delta_o$ being the density of the air at the mouth of the piece and $a$ being 0.00008 according to Siacci and 0.0000745 according to Krupp. For our discussion we have adopted the much simpler expression $\delta_y = \delta_o \ (1 + a y)^{-1}$ in which $a = 0.000085$ and is between the two preceding values.

Substituting the value of $\delta_y$ from this last equation in (1) we obtain

$$(4) \qquad \frac{1 + a y}{v^2 \cos^3 \theta} d(v\cos\theta) = k \frac{d\theta}{\cos^3\theta}, \qquad \text{in which } k = \frac{i \delta_o b}{C g}$$

and $b = 0.000109$, the latter being the coefficient of proportionality which satisfies the relation $F(v) = bv^2$ in the case in which $v$ does not exceed 240 m.

The second member of this equation is an exact differential of which the indefinite integral, putting for brevity, $\tan\theta = p$, may be represented by the form $k\xi_2(\theta)$, in which

$$(5) \qquad \xi_2(\theta) = \frac{1}{2}\left[p\sqrt{1 + p^2} + L(p + \sqrt{1 + p^2})\right],$$

L being the symbol for the Naperian logarithm.

The values of the transcendental $\xi_2(\theta)$ have been tabulated after the manner of logarithms with an argument $\theta$ which varies by degrees. To simplify the calculations, we have sought to determine an approximate expression for the above function which should be rational with respect to the variable $p$ and which should differ as little as possible from the true value. Such an expression, considering the approximation employed in the calculation of ballistic quantities, might be substituted for it without sensible error.

We have found that the given conditions are sufficiently well satisfied by the following approximate expression :*

$$(6) \qquad \xi_2(\theta) = \frac{p(1 + 0.2523 p^2)}{1 + 0.091 p^2}$$

* A comparison of the values of $\xi_2$ $(\theta)$ as given by the two formulas (5) and (6) is shown in the following table.

| $\theta$ | Value of $\xi_2(\theta)$ Exact Formula | Value of $\xi_2(\theta)$ Approximate Formula | $\theta$ | Value of $\xi_2(\theta)$ Exact Formula | Value of $\xi_2(\theta)$ Approximate Formula | $\theta$ | Value of $\xi_2(\theta)$ Exact Formula | Value of $\xi_2(\theta)$ Approximate Formula |
|---|---|---|---|---|---|---|---|---|
| 1° | 0.0174 | 0.0174 | 21° | 0.3931 | 0.3929 | 41° | 0.9688 | 0.9684 |
| 2° | 0.0349 | 0.0349 | 22° | 0.4147 | 0.4145 | 42° | 1.0104 | 1.0101 |
| 3° | 0.0524 | 0.0524 | 23° | 0.4369 | 0.4366 | 43° | 1.0539 | 1.0537 |
| 4° | 0.0700 | 0.0700 | 24° | 0.4595 | 0.4592 | 44° | 1.0997 | 1.0996 |
| 5° | 0.0876 | 0.0876 | 25° | 0.4827 | 0.4824 | 45° | 1.1478 | 1.1478 |
| 6° | 0.1053 | 0.1053 | 26° | 0.5064 | 0.5061 | 46° | 1.1985 | 1.1986 |
| 7° | 0.1231 | 0.1231 | 27° | 0.5308 | 0.5304 | 47° | 1.2520 | 1.2523 |
| 8° | 0.1410 | 0.1410 | 28° | 0.5558 | 0.5553 | 48° | 1.3086 | 1.3094 |
| 9° | 0.1590 | 0.1590 | 29° | 0.5815 | 0.5810 | 49° | 1.3686 | 1.3094 |
| 10° | 0.1772 | 0.1772 | 30° | 0.6080 | 0.6075 | 50° | 1.4324 | 1.4336 |
| 11° | 0.1956 | 0.1956 | 31° | 0.6353 | 0.6348 | 51° | 1.5002 | 1.5016 |
| 12° | 0.2141 | 0.2141 | 32° | 0.6634 | 0.6629 | 52° | 1.5723 | 1.5743 |
| 13° | 0.2329 | 0.2328 | 33° | 0.6925 | 0.6920 | 53° | 1.6500 | 1.6519 |
| 14° | 0.2519 | 0.2518 | 34° | 0.7226 | 0.7220 | 54° | 1.7329 | 1.7349 |
| 15° | 0.2711 | 0.2710 | 35° | 0.7538 | 0.7532 | 55° | 1.8221 | 1.8243 |
| 16° | 0.2906 | 0.2905 | 36° | 0.7862 | 0.7856 | 56° | 1.9181 | 1.9203 |
| 17° | 0.3104 | 0.3103 | 37° | 0.8198 | 0.8192 | 57° | 2.0220 | 2.0243 |
| 18° | 0.3305 | 0.3304 | 38° | 0.8547 | 0.8542 | 58° | 2.1346 | 2.1363 |
| 19° | 0.3510 | 0.3509 | 39° | 0.8911 | 0.8906 | 59° | 2.2570 | 2.2580 |
| 20° | 0.3718 | 0.3727 | 40° | 0.9291 | 0.9287 | 60° | 2.3905 | 2.3904 |

The integration by parts of the first member of (4) gives

$$-\frac{1+ay}{v^2\cos^2\theta}+a\int\frac{dy}{v^2\cos^2\theta}=2k\xi_2(\theta)+C.$$

which, substituting for $dy$ its value from (3) and performing the indicated integration becomes

$$-\frac{1+ay}{v^2\cos^2\theta}-\frac{a}{2g}p^2=2k\xi_2(\theta)+C.$$

The constant of integration C is determined from the conditions at the origin where $v=V$, $\theta=\varphi$, and $y=O$. Placing now $\tan\varphi=p_0$ we obtain

$$C=-\frac{1}{V^2\cos^2\varphi}-\frac{a}{2g}p_0^2-2k\xi_2(\varphi).$$

Substituting this value of C in the preceding equation we have, in finite terms,

$$(7)\quad v^2\cos^2\theta=\frac{1+ay}{2k[\xi_2(\varphi)-\xi_2(\theta)]+\frac{a}{2g}(p_0^2-p^2)+(V\cos\varphi)^{-2}}.$$

Substituting this value of $v^2\cos^2\theta$ in (3) we have

$$(8)\quad \frac{dy}{1+ay}=-\frac{p\,dp}{2kg\,[\xi_2(\varphi)-\xi_2(\theta)]+\frac{a}{2}(p_0^2-p^2)+g(V\cos\varphi)^{-2}},$$

which, replacing the function $\xi_2$ by that of (6) readily reduces to the following differential equation :

(9) $$\frac{a\,dy}{1+ay}=\frac{2}{0.091}\cdot\frac{p+0.091\,p^3}{p^4+a_1p^3-a_2p^2+a_3p-a_4}dp,$$

in which $a_1=0.2523\,a_3$; $a_2=0.091\,a_4-\dfrac{1}{0.091}$;

$$a_3=\frac{4gk}{0.091\,a},\qquad a_4=\left[\frac{4gk}{a}\xi_2(\varphi)+p_0^2+\frac{2g}{a\,V^2\cos^2\varphi}\right]\frac{1}{0.091}.$$

The denominator of (9) being an entire function of the fourth degree with reference to $p$ may be put under the form of a product of two quadratic factors, thus,—

(10) $$p^4+a_1p^3-a_2p^2+a_3p-a_4=$$
$$\left(p^2-\frac{a_3-\lambda_1a_1}{\lambda_1-\lambda_2}p+\lambda_1\right)\quad\left(p^2+\frac{a_3-\lambda_2a_1}{\lambda_1-\lambda_2}p+\lambda_2\right),$$

in which $\lambda_1$ and $\lambda_2$ are the roots of the equation

(11) $$z^2-\omega z-a_4=0,\ \text{in which}$$

$$\omega=\frac{1}{3}\left[-a_2+\sqrt[3]{\frac{1}{2}(\sigma+3\sqrt{3\Delta})}+\sqrt[3]{\frac{1}{2}(\sigma-3\sqrt{3\Delta})}\right],$$

$$\sigma=-2a_2^3+9(a_1a_2a_3+4a_2a_4)+27(a_3^2-a_1^2a_4-4a_2a_4),\quad\text{and}$$
$$\Delta=(a_3^2-a_1^2a_4-4a_2a_4)[2\sigma-27(a_3^2-a_1^2a_4-4a_2a_4)]+$$
$$(a_1a_3+4a_4)^2(4a_1a_3+16a_4-a_2^2).$$

The quantity $a_4$ is essentially positive, therefore the roots $\lambda_1$ and $\lambda_2$ of equation (11) are the one positive and the other negative, and of the two factors composing the second member of (10) one admits of two real roots and the other of two roots which may be imaginary.

Indicating the two real roots by $\gamma_1$ and $\gamma_2$ and by $m\pm in$ the two which might from the first be assumed as imaginary, the identity (10) may take the form

$$p^4+a_1p^3-a_2p^2+a_3p-a_4=(p-\gamma_1)\quad(p-\gamma_2)\quad[(p-m)^2+n^2]$$

and (9) will become

(12) $$\frac{a\,dy}{1+ay}=\frac{2}{0.091}\,\frac{p+0.091\,p^3}{(p-\gamma_1)(p-\gamma_2[(p-m)^2+n^2[}dp.$$

Integrating this equation between the limits O and $y$ corresponding to the limits $p_0$ and $p$ we have

(13) $$L(1+ay)=|A\,L(p-\gamma_1)+B\,L(p-\gamma_2)+P\,L[(p-m)^2+n^2]$$
$$-2\,Q\tan^{-1}\frac{p-m}{n}\Bigg|_{p_0}^{p}=\Psi(V,\varphi,0,k),$$

in which L is, as before, the symbol for the Naperian logarithm and the coefficients A, B, P and Q are calculated by the known

method for the integration of rational differentials. In case all four roots should be real the integral calculus indicates the modification which must be made in the second member of (13) in order that it may be the integral of (9).

From (13), passing from the logarithms to the numbers, we obtain

$$(14) \qquad y = \frac{e^{\Psi} - 1}{a},$$

Eliminating $y$ between (7) and (14) we deduce

$$(15) \quad v^2 \cos^2\theta = \frac{e^{\Psi}}{2k[\xi_2(\varphi) - \xi_2(\theta)] + \frac{a}{2g}(p_0^2 - p^2) + (\text{V} \cos\varphi)^{-2}}$$
$$= \theta(\text{V}, \varphi, \theta, k),$$

which gives the horizontal velocity at any point whatever of the trajectory as a function of the elements at the origin and of the inclination of the trajectory at the point.

It is sometimes interesting to know the value of the minimum velocity $v_1$. In Ballistics this is defined by the general equation*

$$\frac{i\,\delta_y}{Cg}\,\text{F}(v_1) = \sin\theta_1,$$

$\theta_1$ and $y_1$ being the values of $\theta$ and $y$ corresponding to $v_1$.

In our case the preceding equation becomes

$$\frac{k v_1^2}{1 + a y_1} = \sin\theta_1,$$

which by comparison with (14) and (15) becomes

$$(16) \qquad \frac{v_1^2 \cos^2\theta_1}{1 + a y_1} = \frac{1}{k}\sin\theta_1 \cos^2\theta_1 = e^{-\Psi_1}\theta(\text{V}, \varphi, \theta_1, k)$$

from which $\theta_1$ and $v_1$ can be deduced when we know the initial elements V, $\varphi$ and $k$.

If in (14) we make $\theta = 0$, $\Psi = \Psi_0$ and $y = \text{Y}_0$ we obtain

$$(17) \qquad \text{Y}_0 = \frac{e^{\Psi_1} - 1}{a}$$

in which the ordinate of the vertex of the trajectory is given as a function of the initial elements V, $\varphi$, and $k$. This value of the maximum ordinate may be usefully employed in the integration, in finite terms, of the equation of abcissas. To do this, we assume (considering curved fire) that the trajectory is replaced by a parabola of the same altitude and take for $y$, the expression

* Siacci *Ballistique Extérieur*. page 30.

for the ordinate of the parabola at the point corresponding to that of the trajectory.*

On this assumption we have

$$y = Y_0 \left(1 - \frac{p^2}{p_0^2}\right)$$

and therefore, if in the differential equation (2)

$$g\,dx = -v^2\,d\theta = -v^2 \cos^2\theta\,dp$$

we substitute for $v^2 \cos^2\theta$ its value from (7) and then introduce (6) we will have, after some reduction

$$a\,dx = \frac{2}{0.091} \cdot \frac{(1 + 0.091\,p^2)\left(1 + aY_0 - \frac{aY_0 p^2}{p_0^2}\right)}{p^4 + a_1 p^3 - a_2 p^2 + a_3 p - a_4} dp,$$

or performing the indicated division we have

$$(18) \qquad dx = -H\,dp + \frac{b_1 p^3 + b_2 p^2 + b_3 p + b_4}{p^4 + a_1 p^3 - a_2 p^2 + a_3 p - a_4} dp,$$

in which $H = \frac{2\,Y_0}{p_0^2}$;

$$b_1 = Ha_1\,; \qquad b_2 = \frac{2(1 + aY_0)}{a} - H\left(a_2 + \frac{1}{0.091}\right);$$

$$b_3 = Ha_3\,; \quad \text{and } b_4 = \frac{2(1 + aY_0)}{0.091\,a} - H\,a_4\,;$$

the quantities $a_1$, $a_2$, $a_3$, and $a_4$ retaining the values indicated above.

Integrating this equation between the limits O and $x$ corresponding to the values of $p$ as was done in (12) we obtain

$$(19)\; x = H(p_0 - p) + \Big| A^1 L(p - \gamma_1) + B^1 L(p - \gamma_2) + P^1 L[(p-m)^2 + n^2] - 2\,Q^1 \tan^{-1}\frac{p - m}{n}\Big|_{p_0}^{p} = \Gamma(V, \varphi, \theta, k),$$

or, an integral equation similar to this, in case the denominator, which appears in the second member of (18), admits four real roots, as has already been observed above.

Finally, denoting by $\Gamma_0$ the value of $\Gamma$ when $\theta = O$, we have for the abcissa of the vertex of the trajectory, the following relation

$$(20) \qquad X_0 = \Gamma_0(V, \varphi, k)$$

or, as a function only of the initial elements V, $\varphi$ and $k$.

For the point of fall, where $\theta = -\omega$, $v = V'$ and $y = O$, equations (13), (15) and (19) become

$$(21) \qquad \begin{cases} O = \Psi(V, \varphi, \omega, k) \\ (V' \cos\omega)^2 = \Theta(V, \varphi, \omega, k) \\ X = \Gamma(V, \varphi, \omega, k) \end{cases}$$

which, together with the preceding, enable us to solve ballistic problems which do not contain the time.

* Cfr. Siacci, (l. c.) page 45.

We now propose to trace the course that must be followed, in order to solve the problems of fire by means of the ballistic formulas previously deduced, and to find expression in finite terms for the two most important parameters $\beta$ of Siacci.

*Problem 1.*—Given V, $\varphi$ and $\frac{C}{i\,\delta_0}$, to calculate the elements X, Y and V at the vertex of the trajectory.

Formulas :
$$v^2 \cos^2 \theta = \theta\,(V, \varphi, \theta, k)$$
$$L\,(1 + a\,y) = \Psi\,(V, \varphi, \theta, k)$$
$$x = \Gamma\,(V, \varphi, \theta, k)$$
$$k = \frac{i\,\delta_0\,b}{C\,g}.$$

Taking $k$ from the fourth equation and placing $\theta = o$ in the others, we have at once, $V_0$ from the first, $Y_0$ from the second and $X_0$ from the third.

*Example.* $V = 191$, $\varphi = 45°$, $\frac{C}{i\,\delta_0} = 1.682$.

(This is one of the six trajectories which Captain Parodi calculated by arcs, employing Siacci's method. *Rivista d'Artigl. e Genio*, Vol. II, 1896.)

From the above we get $k = 0.0^6\,6606$, which, substituted in the first equation, readily gives
$$V_0 = 120.1.$$

Passing to the solution of the second equation, we find, after performing the necessary numerical computations, that
$$a_1 = 8.455\,;\ a_2 = 6.167\,;\ a_3 = 33.512\,;\ a_4 = 188.526\,;$$
$$\omega = -\ 14.61\,;\ \gamma_1 = 8.25\,;\ \gamma_2 = -\ 22.86,$$
and therefore
$$\gamma_1 = 2.365\,;\ \gamma_2 = -\ 9.655\,;\ \gamma_3 = -\ 0.582 + 2.812\sqrt{-1}\,;$$
$$\gamma_4 = -\ 0.582 - 2.812\sqrt{-1}$$
and finally
$$A = 0.3631\,;\ B = 1.8555\,;\ P = -\ 0.1243\,;\ 2\,Q = 0.0245.$$

Substituting these last values in the second equation and placing $p = o$, we have
$$L\,(1 + a\,Y_0) = 0.069917,$$
from which we find
$$Y_0 = 852.$$

With the value thus found we pass to the calculation of the coefficients
$$H = 1704,$$
$$b_1 = 14407\,;\ b_2 = -\ 4001\,;\ b_3 = 57104\,;\ b_4 = -\ 43963$$
and then
$$A' = 0.13\,;\ B' = 1.285\,;\ P' = 0.0129\,;\ 2\,Q' = 0.1661.$$

Substituting these values in the third of the above equations, we find for $p = o$

$$X_0 = 1634.$$

Calculating the trajectory by arcs, Captain Parodi found

$$X_0 = 1636;\ Y_0 = 846;\ V_0 = 120.3.$$

*Problem 2.*—Given V, $\varphi$ and $\frac{C}{i\,\delta_0}$, to find the range, velocity and angle of fall.

$$\text{Formulas:}\quad \begin{aligned} V'^2 \cos^2 \omega &= \theta\,(V, \varphi, \omega, k) \\ O &= \Psi\,(V, \varphi, \omega, k) \\ X &= \Gamma\,(V, \varphi, \omega, k) \\ k &= \frac{i\,\delta_0\,b}{C g}. \end{aligned}$$

Taking $k$ from the fourth equation and substituting it in the others, we readily obtain $\tan \omega$ from the second. This, in the first equation, gives us $V' \cos \omega$ and, therefore, also $V'$; the range X is deduced from the third equation.

*Example.* $V = 191,\ \varphi = 45°,\ \frac{C}{i\,\delta_0} = 1.682.$

The numerical calculations of the coefficients of the equations are the same as in the preceding problem. Substituting these values in the above equations, we find

$$\omega = 49°\ 6';\ X = 3164;\ V' = 164.$$

Parodi found, approximately

$$\omega = 49°;\ X = 3162;\ V' = 164.2.$$

*Problem 3.*—Given V, $\varphi$ and $\frac{C}{i\,\delta_0}$, to find the minimum velocity and the inclination of the trajectory at that point.

$$\text{Formulas:}\quad \frac{v_1^2 \cos^2 \theta_1}{1 + a\,y_1} = \frac{1}{k} \sin \theta_1 \cos^2 \theta_1 = e^{-\Psi_1}\,\theta\,(V, \varphi, \theta_1\,k)$$

$$1 + a\,y_1 = e^{\Psi_1}\quad ,\qquad k = \frac{i\,\delta_0\,b}{C g}.$$

The solution of the problem is accomplished by trials in the following manner: $k$ being calculated, we assume any approximate value for $\theta_1$, as for example, that, very near the true one, obtained from the expression

$$(22)\qquad \tan \theta_1 = -\,(K + \tan \varphi)\,\sqrt{(K + \tan \varphi)^2 + 1}\ ^*$$

in which

$$K = \frac{1}{2\,k\,\beta\,V^2 \cos^2 \varphi}.$$

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* The expression was deduced from the equations of motion as follows: It is known that, under the assumption of quadratic resistance, if we place

$$z = 2\,g\,k\,\overline{\beta}\,x \text{ and } K = \frac{1}{2\,k\,\overline{\beta}\,V^2 \cos^2 \phi}$$

If we do not know the value of $\overline{\beta}$ we assume $\overline{\beta} = 1$.

With the values of $k$ and $\theta_1$ thus found, we calculate the last two members of the first formula and note if the results obtained are identical. Should this be the case, the value of $v_1$ deduced from the first member will be the one sought; otherwise, the value of $\theta_1$ must be suitably increased or diminished until and exact value is obtained.

*Example.* $V = 191$, $\varphi = 45°$, $\frac{C}{i\,\delta_0} = 1.682$.

Formula (22), taking $\overline{\beta} = 1$, gives $\tan \theta_1 = 0.0962$, or $\theta_1 = 5°\ 30'$; starting with this value of $\theta_1$, we execute the trials indicated below.

| $\theta_1$ | $\frac{1}{k} \sin \theta_1 \cos^2 \theta_1$ | $e - \Psi_1\, \Theta(V, \varphi, \theta_1, k)$ | *Diff.* |
|---|---|---|---|
| 5° 30′ | 14376 | 13300 | 1076 |
| 5° | 13094 | 13308 | − 214 |
| 5° 5′ | 13306 | 13306 | 0 |

We have thus found that $\theta_1 = 5°\ 5'$, is the inclination of the trajectory at the point of minimum velocity, whence, by substitution, we have

$$1 + a\,y_1 = 1.0711\,;\quad v_1 = 119.8.$$

*Problem 4.*—Given V, $\varphi$ and $\frac{C}{i\,\delta_0}$, to find the ordinate, the abcissa and the velocity corresponding to a given inclination.

The formulas are the same as those in Problem 1 and the solution is accomplished in exactly the same manner.

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in which the parameter $\overline{\beta}$ is given a convenient constant mean value, we have

$$(1)\quad v^2 = \frac{V^2 \cos^2 \phi}{\cos^2 \theta}\, e^{-x}, \qquad (2)\quad \tan \theta = \tan \phi - K\,(e^{x} - 1).$$

Differentiating (1) and (2) with respect to $x$ (under the assumption that $\overline{\beta}$ is constant), we have

$$2\,v\frac{d\,v}{d\,x} = V^2 \cos^2 \phi\; e^{-x}\left(\frac{2 \tan \theta}{\cos^2 \theta}\,\frac{d\,\theta}{d\,x} - \frac{1}{\cos^2 \theta}\right).$$

$$\frac{1}{\cos^2 \theta}\,\frac{d\,\theta}{d\,x} = -K\,e^{x}\,.$$

Eliminating between these last equations and (2), the quantities $\frac{d\,\theta}{d\,x}$ and $e^{x}$, we obtain

$$-2\,v\frac{d\,v}{d\,x} = V^2 \cos^2 \phi\;\left(2\,K \tan \theta + \frac{1 + \tan^2 \theta}{1 + \frac{\tan \theta - \tan \theta}{K}}\right).$$

Now, in order that $v$ may be a minimum, $\frac{d\,v}{d\,x}$ must be zero, and hence, indicating by $-\theta_1$ the value of $\theta$ corresponding to a minimum of $v$, we obtain

$$\tan^2 \theta_1 + 2\,(K + \tan \phi) \tan \theta_1 - 1 = 0,$$

or

$$\tan \theta_1 = -(K + \tan \phi) + \sqrt{(K + \tan \phi)^2 + 1}$$

in which the positive sign of the radical is alone considered, because $\theta_1$ must be positive.

*Examples.* With $V = 191$, $\varphi = 45°$ and $\frac{C}{i\,\delta_0} = 1.682$ we have calculated the following table, in which the values obtained are placed opposite those derived from the calculation of the same trajectory by arcs.

| Values obtained from the new formulas. | | | | Values obtained from the calculation by arcs. | | |
|---|---|---|---|---|---|---|
| $\theta$ | $x$ | $y$ | $v$ | $x$ | $y$ | $v$ |
| 30° | 737 | 589 | 147 | 736 | 582 | 147,1 |
| 0° | 1634 | 852 | 120,1 | 1636 | 846 | 120,3 |
| −47° | 3058 | 96 | 158,9 | 3069 | 96 | 159,3 |
| −49° | 3148 | 6 | 163,8 | 3162 | − 6 | 164,2 |
| −60° | 3757 | −910 | 199,3 | 3796 | −918 | 199,9 |

*Problem 5.*—Given V, $\varphi$ and $\frac{C}{i\,\delta_0}$, to find the ordinate, the inclination and the velocity corresponding to any abcissa whatever.

The formulas are the same as in Problem 1. Taking $k$ from the last of these, we calculate $Y_0$ by means of the second, $\theta$ being taken equal to zero; with the value of $Y_0$ thus obtained, we calculate the numerical coefficients of the third equation and from these the value of tan $\theta$ is obtained by trial. This value of tan $\theta$ in the first and second equations readily gives us $v$ and $y$.

*Example.* $V = 191$, $\varphi = 45°$, $\frac{C}{i\,\delta_0}$ 1.682, $x = 3173$.

We find $\theta = -50°$, $y = -52$, $v = 166.3$.

*Problem 6.* Having measured, in a experimental shot, the density of the air, the initial velocity, the angle of projection and the range. and knowing the ballistic coefficient C, it is required to determine $\frac{C}{i}$.

Formulas:

$$Y_0 = \frac{e^{\Psi_0} - 1}{a}, \qquad O = \Psi(V, \varphi, \omega, k)$$

$$k = \frac{i\,\delta_0\,b}{Cg}, \qquad X = \Gamma(V, \varphi, \omega, k).$$

Giving $k$ the approximate value $\frac{\delta_0\,b}{Cg}$, we find from the first equation the corresponding value of $Y_0$ and calculate the coefficients of the fourth equation. From the latter we deduce by trials a first value of tan $\omega$ which we substitute, together with the value of $k$, in the second equation. If the second equation is thus

satisfied, it means that the value of $k$ is exact and that the value of $\frac{C}{i}$ can not be determined unless $k$ is made to vary suitably and the calculations repeated until the true value is obtained by successive approximations.

*Problem 7.*—Given $x$, $y$, V, $\varphi$ and $\frac{C}{\delta_0}$, to find $\frac{C}{i}$.

The method is the same as that indicated in the solution of Problem 5. This problem has the same importance as the preceding when we have to construct a table of fire for a sea-coast howitzer or mortar, for the reason that from the table of fire calculated for the horizontal line of the piece, we derive but approximately the elements of fire for a point located outside of that horizontal line. In a fire as delicate and important as that of sea-coast artillery, every economy in the preparation of the tables must be avoided, and therefore, it is essential to execute the series of ballistic firings of the battery, to observe the points of fall upon the sea, and to deduce from these the data for the correction and calculation of the said table.

*Problem 8.* Given V, $\varphi$ and $\frac{C}{i\,\delta_0}$, to find the analytical expressions which give the values of the parameters $\overline{\beta}$ of Siacci, as functions of these elements.

It is known that each of the four formulas of fire which, according to Siacci's method, gives the abcissa, the ordinate, the inclination and the time as a function of the pseudo-velocity $u = \frac{v \cos \theta}{\cos \varphi}$, expresses a like number of complementary parameters $\beta_x$, $\beta_y$, $\beta_\theta$, $\beta_t$, which are the various mean values of the variable

$$\beta = \frac{\delta_y \, F\,(v) \cos \theta}{\delta_0 \, F\,(u) \cos^2 \varphi}$$

between the limits of integration. If these parameters were known analytically, Siacci's formulas would give the rigorous solution of all the ballistic problems consistent with the law of resistance adopted. Now, since all the equations of fire contain $u$, if the value of this quantity is not sought, and it is required, for example, to determine $y$ or $\theta$ corresponding to $x$, it suffices, in order to solve these two problems, to substitute in the two corresponding equations, for $\beta_x$, $\beta_y$, $\beta_x$ or $\beta_\theta$ a common value, which, though differing from the true value, is yet unimportant to know. We will indicate by $\overline{\beta}$ and $\overline{\beta_1}$ these two particular values of the function which serve, so to speak, for the solution of the two problems under consideration. Siacci called the first $\overline{\beta}$ principal, and

tabulated it as a function of X and $\varphi$ ; we will endeavor to develop here, an analytical representation of both for the case of a quadratic resistance.

Siacci* observes that the most natural method of determining $\bar{\beta}$ is to establish two relations between X, V and $\varphi$, only one of which shall contain $\bar{\beta}$, then to eliminate one of these three quantities, as, for example, V, whence we obtain $\bar{\beta}$ as a function of X and $\varphi$. Let us apply the same method, observing, however, that it will be more convenient for us in the end, to eliminate X, thus obtaining $\bar{\beta}$ and $\bar{\beta}_1$ as functions of V, $\varphi$ and $\frac{C}{i\delta_0}$. The coefficient $\frac{C}{i\delta_0}$, it is true, does not appear in Siacci's table of $\bar{\beta}$, but this is due to the approximation which the author had to adopt, which, considering only the first term of the final series, in effect, neglected those containing the said coefficient.

For the point of fall, where $u = U$, the first three formulas of fire, in case of quadratic resistance, become

$$X = \frac{LV - LU}{g\,k\,\beta_x} \tag{23}$$

$$\sin 2\varphi = \frac{1}{k\,\beta_y\,X\,V^2}\left(\frac{V^2 - U^2}{2\,g\,k\,\beta_x\,X\,U^2} - 1\right) \tag{24}$$

$$\tan\omega = \frac{1}{2\,k\,\beta_\theta\cos^2\varphi}\left(\frac{1}{U^2} - \frac{1}{V^2}\right) - \tan\varphi \tag{25}$$

to which may be added the first of (21), which is

$$\Psi(V, \varphi, \omega, k) = O.$$

Knowing V, $\varphi$ and $k$, we can deduce $\tan\omega$ from this last equation, and hence we can write

$$\tan\omega = \frac{F(V, \varphi, k)}{2\,k\,V^2\cos^2\varphi}. \tag{26}$$

Eliminating U between (23) and (24), we have

$$k\,\beta\,V^2\sin 2\varphi = \frac{e^{2gk\beta X} - 1}{2\,g\,k\,\beta\,X} - 1, \tag{27}$$

and eliminating U and $\tan\omega$ between (23, (25) and (26), we obtain similarly

$$k\,V^2\sin 2\varphi = \frac{e^{2gk\bar{\beta}_1X} - 1}{\bar{\beta}_1} - F(V, \varphi, k). \tag{28}$$

We thus have two equations which unite $\bar{\beta}$ and $\bar{\beta}_1$ respectively to the quantities X, V and $\varphi$.

*Exterior Ballistics, page 406.

There now remains but to deduce, independently of these parameters, a relation between the same quantities, and then to eliminate one of them. To this end we will use of the third equation (21) which, substituting for tan $\omega$, its value from (26), becomes an explicit relation of X with the known quantities V, $\varphi$ and $k$, that is, a relation of the form

$$X = f\,(V, \varphi, k).$$

Eliminating X from (27) and (28) by means of this value and placing, for brevity

$$2\,g\,k\,\overline{\beta}\,f\,(V, \varphi, k) = Z \quad \text{and} \quad 2\,g\,k\,\overline{\beta}_1\,f\,(V, \varphi, k) = Z_1$$

we have the equations which furnish implicitly, but in finite form, the values and $\overline{\beta}$ and $\overline{\beta}_1$, thus,

$$k\,V^2 \sin 2\,\varphi = \frac{1}{\overline{\beta}}\left(\frac{e^z - 1}{Z} - 1\right) \tag{29}$$

$$k\,V^2 \sin 2\,\varphi = \frac{e^{z_1} - 1}{\overline{\beta}_1} - F\,(V, \varphi, k). \tag{30}$$

The calculation of these expressions is not easy nor expeditious, they can not, however, be avoided, if we would render rigorous the application of Siacci's formulas to the solution of of problems of fire when the resistance is quadratic.

*Example.* $V = 191$, $\varphi = 45°$, $\dfrac{C}{i\,\delta_0} = 1.682$.

From Problem 2 we take

$$F\,(V, \varphi, k) = 0.2782, \quad X = f(V, \varphi, k) = 3164,$$

entering Siacci's table with this last value, we find that for $\varphi = 45°$ $\overline{\beta} = 1.2$, and this is the value with which we begin the series of trials for the solution of (29) and (30). In the table below have been collected the calculations necessary for this purpose.

**Calculation of $\overline{\beta}$.**

| $\overline{\beta}$ | Z | $\frac{1}{\overline{\beta}}\left(\frac{e^z - 1}{Z} - 1\right)$ | $k\,V^2 \sin 2\,\phi$ | Diff. |
|---|---|---|---|---|
| 1.2 | 0.4921 | 0.2433 | 0.2410 | 23 |
| 1.1 | 0.4511 | 0.2400 | 0.2410 | — 10 |

$$\overline{\beta} = 1.1 + 0.1 \times \frac{10}{33} = 1.13$$

| | | | | |
|---|---|---|---|---|
| 1.13 | 0.4634 | 0.2407 | 0.2410 | — 3 |

$$\beta = 1.143.$$

Calculation of $\overline{\beta}_1$.

| $\overline{\beta}_1$ | $Z_1$ | $\frac{e_1 - 1}{\overline{\beta}_1} - F(V, \phi, k)$ | $k V^2 \sin 2\phi$ | Diff. |
|---|---|---|---|---|
| 1.2 | 0.4921 | 0.2516 | 0.2410 | 106 |
| 1.1 | 0.4511 | 0.2402 | 0.2410 | − 8 |

$$\overline{\beta}_1 = 1.1 + 0.1 \times \frac{8}{114} = 1.107.$$

| | | | | |
|---|---|---|---|---|
| 1.107 | 0.4540 | 0.2409 | 0.2410 | − 1 |

$$\overline{\beta}_1 = 1.108.$$

Prof. A. Bassani.

[Translated by Lieut. F. E. Harris, 3d Artillery.]

# THE STUDY OF SEA-POWER.

D. BONAMICO.

Reprinted from *Marine Rundschau.*

[Continued].

## e. THE DENSITY OF POPULATION.

Mahan regards the density of population as an element of military defense inducing extension and therefore, as being related to the expansive and productive strength of the country.

As the characteristics which he adduces do not satisfy the requirements of a fundamental study, we consider it opportune to supplement them with the following principles:

1. A large population, be it land or seafaring, is in itself, under the conditions considered below, always an active element of sea-power.

2. A large land population is an indirect foundation for naval efficiency, unless it foments a discord inimical to the stability of the state.

3. A large seafaring population is now, as in the past, the most active element of sea-power.

4. The density of the seafaring population must, above all things, satisfy the requirements of national defense, and, therefore, be commensurate to the development of the coast-line, if the latter be regarded as the defensible frontier of the country.

5. A country may be conceived as a fort, of which not only must the garrison be proportionate to the extent of the enclosing girdle, but the tactical zone must be commensurate to the means and systems of defense.

6. The density of the seafaring population must be such that after satisfying the requirements of defense, it still has a surplus available for outward expansion.

7. Since the population almost always increases more rapidly than the productiveness of the country, the probability of a surplus of the expansive capacity is greater than that of a deficiency.

8. Since the preservation of the material welfare is the fundamental condition of national stability, the surplus population must be employed in expanding.

9. In order that the surplus population may signify an increase of national strength, the road to expansion must be open, or at least but slightly obstructed ; the expansion surplus, to be

a source of defense, must, therefore, bear an exact relation to the total capacity of the state.

10. The surplus population constitutes a reduction of national strength if it exceeds the limits of the possibility of expansion set by the international position of the state.

11. The surplus population tending towards expansion, is apt to be dispersed, divided or even prejudicial, if it is abandoned to centrifugal impulses and the national career is lacking in centripetal force.

12. The surplus population is the more valuable, the more directly it can be employed as an economic and military reserve.

13. In all periods of sea-history, there has been lacking an organic preparation of reserves for the purpose of solidifying the national strength.

14. The advantage of a reserve personnel is the more important, the greater the surplus of the materiel and the greater the probability of employing it in long wars.

15. The importance of a reserve personnel is, from the character of modern fleets and sea-battles, less striking and domineering than in former times, but its organization is always a source of national strength.

16. The degree of the power of expansion of the surplus determines the vital strength of the state.

### f. THE RAMIFICATIONS OF SEA-TRADE.

The industrial productive capacity of a country, is generally, it is true, regarded as an element of power production, but the special conditions governing it have been but little investigated.

Mahan himself has alluded to industry but indirectly, by conceiving it as a generator of the material reserve during war: he has not, however, occupied himself at all, with the influence of the industrial development upon sea-power.

A few considerations upon this subject were presented by us in a previous investigation; the novelty and intricacy of the subject, however, require numerous investigations in other directions, before a satisfactory result can be hoped for; in the mean time, we venture to lay down the following brief views:

1. The industrial activity may be divided into two great classes—natural and artificial—according as the country does, or does not produce, the raw material requisite to the exercise of the industry.

2. The natural industrial activity, whether it satisfies the requirements of maritime or inland intercourse, is always an indication of maritime strength.

3. The industrial activity influences all periods of the rise and development of sea-power ; its influence is, however, far less perfect and far more ephemeral than that of the density of population.

4. Almost all characteristics of the relations between the density of population and expansive capacity are, properly considered, correspondingly applicable to the industrial density.

5. The artificial industrial activity is the more unstable and imperiled, the more it depends upon the safety of the international communications.

6. A large and predominating artifical industry cannot exist without a considerable sea-power.

7. Conceived as an industry, the fleet is artificial, unless business in general, including ship-building, has a firm foundation in the productive strength of the country.

8. War fleets are immaterial or practically artificial. if they are not a natural production of the country's consciousness or endownment.

9. The great maritime industries must lie inland with free egress to the sea, and must be protected against seizure by a proper coast defense.

10. Industrial centers which lie at easily vulnerable points of the coast, constitute a great weakness to sea-power.

11. Long periods of peace induce the development of artificial industries at vulnerable points, from which there results, in subsequent long periods of war, only economic and military misfortunes.

12. Military-maritime ascendency, only attainable with difficulty, is the more indispensable, the more artificial the industry and the more vulnerable its location.

13. The vitality of the state must be very great where the artificialness of the industry is very great.

14. With few exceptions, modern fleets, by their vulnerability and artificialness, presuppose a large political and military power.

15. The wars of the future will quickly dispel the delusions which a long period of peace at sea and the lassitude of the political powers, have caused to arise in the consciousness of the nation.

16. The artificialness of almost all modern fleets constrains the conflict to the greatest intensity and shortest duration.

17. The more the artificialness depends upon the lack of the means of mobilization, the more imperative is the rapid

acquisition of sea-dominion or the possession of a commanding position.

18. The conflict can be delayed by such fleets only, as have positions permitting of a long defense and of a favorable employment of the movable reserves, already accumulated or yet to be accumulated.

19. Since, owing to the military position or character of the war, delay may be either favorable or necessary, it is indispensable to create fleet stations, which permit of the concentration and maintenance of the fleet in a fighting condition.

20. The predominance of the artificialness can only be reconciled through mutual political obligations.

The views, commonly held, on the efficiency and security of maritime trade, are generally erroneous and exaggerated, because based, for the most part, on the improvement of fleets and the unusual endurance of peace at sea, the latter precluding the instruction which can only be gained through war.

Notwithstanding that both the last wars were fought out in distant seas, they nevertheless contributed towards correcting a number of erroneous views ; a great war, fought out in European waters, particularly in the Mediterranean Sea, would completely dispel the illusions, and indicate the proper views on the influence of industry upon sea-power.

### g. WEALTH.

The views on the influence of wealth upon sea-power, are so indefinite and disconnected, that it will certainly be difficult to trace out the first steps of truth for the foundation of the study of sea-power.

Is wealth an active element of sea-power or not?

Mahan seems to exclude it by stating that the necessary conditions are those which, combined with others, cause the production of naval efficiency. Napoleon, on the contrary, asservates, "C'est l'argent qui fait la guerre." As money is undoubtedly an important factor of the expansive capacity, it seems desirable to learn, if, and how, a force impelling to extension resides within prosperity.

Modern military literature almost always considers wealth as an important preliminary condition of modern war; in the investigation of most of the historical revolutions, we find, however, that wealth has influenced the great developments in a negative rather than in a positive direction.

The problem presents itself, therefore, as very complex and difficult of solution, and we certainly do not claim to give a com-

plete or even an approximate solution. Now, however, that we have made an attempt, we wish to carry it through to the end, and thus lay down the following brief principles which exhibit, with some degree of probability, the influence of prosperity on naval efficiency.

1. Conceived as a social phenomenon, wealth exhibits itself as accumulated work and is capable of being palpably advantageous.

2. For our purpose wealth must be regarded as valuable, not so much in itself, as for its value with reference to sea-power.

3. Prosperity depends chiefly upon the character of the race and upon its education, consequently upon the incommensurable quantities of sea-power; since, however, it is a material phenomenon, it belongs also to the commensurable quantities.

4. Prosperity influences the development of sea-power more than it does its conception.

5. Great poverty with density of population may induce expansion, it does not permit, however, of an effective employment of the forces, which are thus, for the greater part, lost.

6. Wealth contributes to making the expansion effective rather than to calling it forth.

7. Without the assitance of wealth the expansive faculty can only, with difficulty, create an important sea-power.

8. Prosperity acquired during the first periods of expansion, is not always useful to further development and sea-power.

9. Prosperity which does not aim to increase the vital and productive strength of the nation, is a transitory element of power.

10. The increase in vital strength derived from initial expansion, must not be taken from the sphere of expansion, but must remain to support it.

11. Wealth exhibits an inefficient or efficient element of power, according as it is accumulated and invested or is led back into the economic sphere of expansion.

12. Wealth is real or apparent, according as it produces economic accretions, or is applied to elements unfavorable to expansion.

13. Should wealth be left to itself, it becomes converted to material well-being and slips out of the sphere of production.

14. Wealth which is invested in splendor or is the remnant of past dominion, accomplishes nothing for the expansive faculty.

15. Wealth expended or squandered to increase the material welfare, is much more a cause of weakness and decay than a source of strength.

16. The more the needs and requirements of material welfare grow, the more the strength of expansion is diminished.

17. Prosperity which springs especially from commerce, is a less certain and efficient element of power than that which springs from the productive strength of the country.

18. Similarly, prosperity derived from industrial channels is less firmly established than that springing from the productive capacity of the soil.

19. Should the wealth consist in credit or bullion reserves, it can still form an important active element of the political and military potency, though it may often, also, prove deceptive.

20. Prosperity is the more efficient, the greater is its outward striving force and the greater is its animation within the limits of the state.

21. The state is unable to create prosperity, it must, however, control and guide it within the sphere of its expansive limits.

22. Private wealth is inclined to withdraw from state control; strong tradition and wise legislation can and must hold it firmly within the sphere of expansion.

23. The republic of Venice ought to be proud of very wise legislation and efficient traditions.

24. The state and its citizens must be mutual and contributory factors of prosperity and expansion, and ought, therefore, to exercise a reciprocal guard over the public and private undertakings.

25. The universal prevalence of the yearning of the democracy of usefulness for immediate material happiness, threatens to weaken the strong and true activity of the expansive faculty of prosperity.

26. Since almost all nations live unconcerned for the future, prosperity, now-a-days, is more an apparent than a real element of the expansive strength.

27. The wise distribution of prosperity considered with reference to the active circulation and as a reserve, is a powerful guaratee of the economic equilibrium and of sea-power.

These principles form but a very incomplete outline of the study of wealth; they permit, however, the inference that of the European nations, England alone has a powerful organization of prosperity, Germany is perhaps on the way towards its creation, and France, rather likely, on the way towards its destruction, whilst all other nations are exhausting themselves in impotency.

### III. THE INCOMMENSURABLE QUANTITIES.

The statics of sea-power also treats of incommensurable quantities, which are even less accessible to an approximate determination than the commensurable quantities just treated. As stated above, the most important of these quantites which exercise an influence upon sea-power, great but difficult to estimate, are the national character, the form of government and the civilization.

Mahan has not regarded the civilization of the population as one of the quantities of sea-power, for the reason, as indicated above, that his investigations were limited to a short period of history and to nations whose state of civilization, though not high, did not differ essentially. The part of the study which treats of civilization has not, therefore, received, as yet, its baptism at the font of history at the hands of the American author who, though he has not lavished the consecrated water open handedly, has yet exhibited the most important historical features of the national character and of the character of the government in its proper light.

The principles which concern the national character and the form of government find, therefore, a sufficient, though incomplete foundation in the works of Mahan, while those relating to the civilization, boasting but a modest paternity, are commended to the indulgence of the reader.

#### a. THE NATIONAL CHARACTER.

The influence which the national character exercises upon naval efficiency seems still more extended and complex than that which is restricted to the commercial and colonial tendencies of the population. Mahan believed that the influence of the national character could not extend beyond the commercial and colonial spheres. Considering that the Hebrews, Phoenicians, Genoese and Dutch were greatly devoted to commerce and colonization and yet did not succeed in establishing an enduring sea-power, we must conclude that the study of sea-power with reference to the national character ought not be restricted to the bounds drawn by Mahan, and that outside of the talent for commerce and colonization, we must consider still other quantities depending upon the national accomplishments.

Having considered the opinions of Mahan, as previously stated, as well as some ethnical characteristics designed to incline the nation towards the sea, we believe this part of the study of sea-power ought to be based on the following principles:

1. The tendency towards the sea considered from the standpoint of the study of nations, is composed of unconscious instincts, of talents for administration, commerce, colonization and adventure, and of the warlike propensities of the races.

2. The unconscious instinct and the talents depend, for the most part, upon the natural racial character, they can be gradually so varied by education and the struggle for existence, as to determine by their reciprocal action the national character.

3. The limitations due to changed economical and political conditions of existence, determine the development of the natural instinct more than those of education; they often prove, however, incapable of changing the national character from land life to sea life and conversely.

4. The national character is generally very stable and of slow development; its activity, however, is so complicated, so surprising and so incalculable, that it is impossible to distinguish it from the incommensurable forces of sea-power.

5. Since naval efficiency, as already indicated, * is far less stable and easier to disturb than land efficiency, the instinct towards the sea must be characterized by a greater capacity for adaptation to these conditions of instability and disturbance.

6. Impulsive and nervous races fond of adventure and novelty, have greater natural talents for sea-life than apathetic, sluggish, methodical, and patient ones.

7. Races whose religion induces fatalism, contemplation and acquiescence, are less qualified for a sea-life than those which are broader minded and possess greater freedom of conscience and of research.

8. Races with patriarchal, fuedal and knightly instincts, incline less to life upon the sea than nomadic, democratic and commercial ones.

9. The intermixture and promiscuous aggregation of races, particularly through constant immigration, favors the development of those characteristics which best correspond to maritime requirements.

10. Seldom do all instincts and talents for sea-life contribute to the cultivation of a great national fitness for the sea.

11. The economic instincts are rather different among the different nations, according as speculative daring or fear of risk, large capitalization or small realizations, open confidence or open mistrust, private enterprise or state paternalism, and an inclination either to production or consumption predominate.

* Naval strategy (*Strategia navale*) chapter II.

12. Speculative daring, mutual public responsibility, large capitalization, instinct for production and private enterprise, are valuable economic activities of sea-power.

13. The instinct for production of values, for speculation, economy, commerce and colonization, are seldom found united in one and the same race, but less seldom still are they permeated with the warlike talents indispensable to the maintenance of the stability and permanence of sea-power.

14. The races which have the best talents and inclinations for sea-life, generally lack the warlike quality even if they possess the courage ; and only a powerful direction on the part of the state can overcome this deficiency, which almost always causes a rapid disorganization.

15. With the exception of Venice and England, almost all historical naval states in which seaman-like inclinations and talents prevailed, lacked warlike qualities and this, notwithstanding their many victories and deeds of heroism.

16. The warlike quality differs for the seaman from that of the soldier, for the same reason that the naval esprit differs from that of the military ; the latter is especially an indication of the feeling, while the former is chiefly composed of the organizing and intellectual forces of the people.

17. The English is undoubtedly that nation of Europe, or we might say of the world, which possesses, now-a-days, the greatest talent and inclination for a sea-life, since all other nations lack, more or less, the economic or military seaman-like character.

These principles permit the approximate estimation of the seaman-like endowment of nations, insofar as it depends on the national character ; the difficulty, however, of harmonizing the military with the economic inclinations complicates the problem to such an extent, that it appears to preclude the possibility of determining the total amount of the ethnical influences.

### b. THE FORM OF GOVERNMENT.

The influence of the form of government upon the conception and development of sea-power, has been so thoroughly investigated by Mahan and discussed by us in previous works, that we may, without further discussion, lay down the following principles :

1. The vital strength of the state is always indispensable to the attainment of a dominating and enduring sea-power.

2. The power of the state can compensate for the national weakness by the attainment of naval efficiency, but the weak-

ness of the state can only be compensated with difficulty by the national expansive force.

3. The form of government influences the conception and development of sea-power according to the character of the inclinations.

4. That form of government best corresponds to the requirements of sea-power which imbibes most from the national spirit and is conscious of the national interest.

5. The internal cohesion between government and national consciousness does not exist if the latter is roused or easy to arouse, corrupted or easy to corrupt.

6. The degree to which the national spirit permeates the government and the reciprocal action of its adverse influence determine the variable plenary power of the state.

7. The instability and ease of disturbance of naval efficiency, require, in comparison with land efficiency, a forcible and permanent control on the part of the state.

8. Despotism comprehends but with difficulty the true national interests, and absorbs the national spirit with still greater dfficulty; it is capable, however, of creating a great sea-power from the strength incident to the powerful government which it is permitted to exercise.

9. Since the internal strength of autocratic government is variable and unstable, the sea-power, though it may attain a great temporary and sudden height, will not acquire the organic stability indispensable to the permanence of its predominance.

10. In consequence of the pesonal nature of autocracy, despotism inclines more to the direct pursuit of military or political aims than to the protracted advancement of economic endeavors.

11. Despotism can harmonize, but with difficulty, its political and military plans with the national potentiality, and calls forth, therefore, deceptive phenomena, which almost always results in the exhaustion of the state.

12. Owing to the predominance of the autocratic personality of the ruler, despotism has a greater inclination and capacity for developing the land forces than the sea-power, provided a possibility exists of choosing between them.

13. Monarchic as well as republican representative governments, may be permeated, in the highest degree, with the national spirit and permit the national consciousness to assume an extensive share in the control of the state; in comparison

with despotic governments, they almost always, however, lose in internal strength what they gain from liberalization.

14. Its capacity to create and strengthen sea-power, is diffierent according as it permits a predominance of a democratic or aristoratic spirit.

15. Representative governments founded on prevailing democratic principles and particularly republican governments, incline to the pursuit of the urgent and useful undertakings which lie immediately at hand, and are, therefore, in a condition to develop the economic and mercantile forces which are demanded by sea-power.

16. Democratic republics are naturally unstable, tend to transgression of the law, are corruptible, cannot keep within bounds, and frequently degenerate into demogogies or are transformed into autocracies; they lack, therefore, the stability indispensable to bestow endurance to naval efficiency.

17. Since democracy and autocracy do not possess consistency either in their systems or in their aims, but are led to profit from sudden impulses and urgencies, they have proved incapable, as shown by history, of conferring stability and endurance to sea-power, though they have occasionally produced them and are in a condition to call forth phenomena which are very strong in themselves.

18. Democracies show a greater ability for developing sea-power than land-power, in case there exists a choice between the two.

19. Democracies show themselves the less potential, the more agitated and perverted their national consciousness and the sharper the conflict of interests on land and sea.

20. Monarchic or republican representative governments based on an aristocracy, having many talents for harmonizing the proximate with the remote, the politcal with the economic, and the military with the useful aims, permit the greatest blending of the material welfare with the state power.

21. As history shows, the aristocratic government has exercised the greatest power at sea, compensating an occasional lack of internal strength by the great stability and consistency of the government.

22. The forms of representative governments in actual existence are, in consequence of the excessive predominance of democracy and the impotence or mutability of the executive power, more or less incapable of maintaining an enduring sea-power.

23. The inefficiency of the aristocratic element produces a great imperfection in representative governments and a great weakening in state power.

24. Representative governments must strengthen the aristocratic element which, through choice and selection, proceeds from all classes of people, and must cultivate a cast of noblemen in which the stability of the state is expressed.

25. The persistence of aristocracy in the government, in spite of the increasing infiltration of democracy, is not the ultimate cause of the stability and endurance of the predominating naval efficiency of Great Britain.

The common prevalence of representative governments as opposed to despotic and dictatorial, well nigh leads to a destructive dismemberment of the strength of monarchic and republican governments, in order to define with greater certainty their actual influence upon sea-power.

Considering, however, that the difference between monarchy and republic is, now-a-days, restricted to the descendibility and temporalness of the sovereignty, that is to say, is more the expression than the substance of the executive power, we can conclude that the plenary power of the state will diminish in proportion as democracy wedges in; as sovereignty is trampled under foot or swept aside; as the exercise of state power is disturbed by the instability of the executive authority; as national consciousness vacillates and is corrupted.

Upon these principles as a basis, it will not be difficult to determine the proportionate strength of governments, if we know the elements from which they are derived.

The solution of the problem will be the easier and more exactly approached, the more the state power depends upon the laws and constitution peculiar to it; and, therefore, upon the exclusion or abatement of the influence of the governing personality.

As this influence will not permit itself to be wholly excluded, this element of naval efficiency does not belong to the commensurable quantities; but the caprice, the personality, can be compensated, more or less, through the equality and supervision of the masses: whence it may be concluded, that the more the latter is organized, the more will the influence of the personality and the indeterminateness of the problem be insignificant.

### C. THE CIVILIZATION.

It is much easier to understand what civilization is than it is

to explain it, and just as much easier to estimate its influence than it is to determine its causes.

The character of the civilization depends, for the most part, on both the incommensurable quantities just treated, viz.: the national character and the form of government. Since these, however, do not suffice for a complete explanation, we deem it opportune to present some general reflections upon this historical phenomenon.

The influence which civilization exercises upon mundane events, though often superficially indicated by historians and philosophers, has not been subjected to the rigid analysis essential for the investigation of the principles which govern these quantities.

Independent of all other active elements which co-operate in the power formation of a state or during an epoch, civilization exercises an influence of its own, with which a thorough acquaintance is of interest.

Those who regard the cannon as the sole power emblem of civilization, will undoubtedly find the investigation of the other power embles rather difficult; considering, however, that the latter are pretty frequently derived from the former. we are forced to conclude that this power has its origin in civilization.

The conflicts between Rome and Carthage, between Venice and Constantinople, between England and Spain, between Japan and China, between the United States and Spain, were particularly those between conditions of civilization, wholly or partially dissimilar, and in which the different potentiality of civilization was plainly the predominating influence; this will likewise be true in the future.

The investigation of the characteristics of this power is certainly difficult, and the problem has not been simplified by previous investigations; a long and affectionate occupation with the subject, however, gives us the courage, relying upon the indulgence of the reader, to present the following general principles:

1. Civilization may be regarded as a compound and complicated phenomenon in which all state and national forces participate; the affinities of these forces will differ according to the different races comprising the state.

2. The character and activity of the affinity, depending on which of the forces predominate, can produce definite heterogeneousness among the races participating in one and the same civilization.

3. The heterogeneousness of the races gives the state an uneven plenary power and induces the people to a dissimilar exercise of the land or sea dominion.

4. According to the character and modification, civilization is more perfect and active, the more it is capable of equalizing the social, intellectual and governing forces, and of directing them upon a common aim to the advantage of the state power.

5. The social activity springs particularly from religion and from the feeling of national community ; its efficiency is particularly shown by the undeviating pursuit of the national ideal.

6. The intellectual activity springs from scientific research, whether theoretical or practical, and is particularly manifested in the preservation of the expanding vital energy of the state.

7. The governing activity is based particularly on the principle of authority, whether personal or general, and advances particularly in the adjusted life of the state.

8. The characteristics of the social and governing activities are power of perseverance and immobility respectively, that of the intellectual activity, evolution ; the former, therefore, determines peace, the latter, the motion of the system.

9. The excessive predominance of one or the other of these quantities disturbs the equilibrium of the natural system of forces and causes a weakening of the state.

10. If the social activity is composed exclusively of religious feeling, it is only with difficulty that a corresponding development of the intellectual activity is permitted, the effect being to greatly retard the development of the vital energy of the state.

11. Should the intellectual activity incline to positivism or materialism or skepticism, it would rarely permit the development of the social and governing activities, and would induce a weakening of the perception and a decadence of the national strength.

12. If the governing activity inclines to rigid bureaucracy and materialism, it retards the development of the social and intellectual forces, and diminishes the elasticity of the body politic.

13. Owing to the predominating religious and social activities, to the discord between feeling and intellect, and to the conflict between church and state authority, the catholic religion precludes the full activity of the intellectual and governing quantities and induces a decadence, more or less great, of the national strength.

14. Owing to the exclusion of conflict between church and

state authority, the Greek-catholic civilization, though having much in common with the catholic, permits a greater activity of the national strength.

15. Although the protestant religion does not arouse any strife between the social, intellectual and governing forces, it is, nevertheless, little suited to strengthen their mutual relations; it is rather doubtful, therefore, whether the greater equalizing capacity compensates for the lesser internal strength of the system.

16. The scientific civilization, under the assumption of its future existence, will yield sufficient internal strength and harmony of its activities; the great difficulty, however, of establishing a new morality based on a new authority, arouses the apprehension that the hitherto unattained condition will remain an unattainable ideal.

17. The relative strength of these different civilizations eludes a rigorous determination, for the reason that the latter depends upon the different degrees of strength of the conflicts caused by the activity of the civilization and upon the strength of the bonds uniting them; it may, however, be approximately assumed,—

a. That the scientific civilization is still unknown,

b. That the protestant civilization possesses a great equalizing talent,

c. That the Greek-catholic civilization is less active, now-a-days, than the protestant,

d. That the catholic civilization is, of all, the least active.

18. The estimation of the relative strength of civilizations with reference to their effect on naval efficiency is approximate, if the results indicate that, other things being equal, the requirements of sea-power are best satisfied by the intellectual activity.

19. New conditions of civilization, arising from new religous, scientific and social institutions, are generally capable of great initial extension; the absence, however, of reserve strength, makes it seem very questionable whether they possess the capacity of endurance and resistance necessary in battle.

20. Even if the forces of the settled conditions of civilization are not exhausted or impaired, they generally have a slighter extension impulse than the new; but their power of perseverance and their reserve vitality grants them great resisting power in all conflicts, whether internal or external, moral or physical.

21. According to the law of evolution, old civilizations incline the more rapidly towards social and physical exhaustion, the

more their power of perseverance predominates over the activity of the system.

22. Every civilization, like every individual, includes within itself the germs of its vitality, but the dissimilar conditions of evolution preclude the possibility of tracing, in time and space, the curves of the different conditions of evolution.

The foregoing views relate particularly to the influence of civilization upon the total strength of nations without regard to the different forces which shape it.

The complicated character of the phenomena does not permit a closer analysis, but the series of principles relating to the individual spheres of action permit an approximate estimation of the particular influence which may be exercised by the condition of civilization upon land and sea power.

Thus, proceeding from the simple to the complex phenomena, we were enabled to lay down the series of principles concerning the statics of sea-power. However incomplete and imperfect this part of the study may be, it, nevertheless, may be regarded as a sufficient basis for passing to the investigation of the leading characteristics of the dynamics of sea-power.

## PART II.

### THE DYNAMICS OF SEA-POWER.

If the mutually dependent quantities considered in the first part, pass from the condition of equilibrium to that of motion, they introduce a new kind of phenomena, with whose peculiarities and fundamental laws it is important to become acquainted.

Before passing to a determination of these laws, it is desirable, if not demanded, to explain the idea of national dynamics, in order to preclude the possibility of the more common and subjective conceptions.

Since dynamics, mathematically stated, is the study of motion under forces, it follows that by national dynamics, is to be understood that particular study, which aims at the knowledge of the peculiarities of the national expansive motion, from its rise upon the national stage to its entrance upon the international theater.

As our investigation is limited to the study of sea-power, we subject to a test, those forces, particularly, which, directly or indirectly, contribute to the requirements of the expansive force at sea.

The expansive force has two spheres of activity,—the national and the international. Conformably to the requirements of the

order and clearness of the investigation, we investigate first, the laws of internal motion, then those of the external expansion.

### A. THE INTERNAL DYNAMICS OF SEA POWER.

The internal and external dynamics form two distinct parts of the dynamics of sea-power.

Since internal dynamics has for its object the investigation of the expansive motion from its conception to its entrance upon the international stage, just as that of internal ballistics is the investigation of the laws of expansion within the bore of the gun, so must it examine the principal phenomena of the internal development and present it in such logical sequence, as to render the scientific consideration of its expansive capacity both easy and clear.

#### a. THE NATIONAL ECONOMY.

This quantity of internal dynamics is composed of many forces, since all national forces contribute, more or less, towards the expansive capacity of the state. We restrict ourselves here, to those forces only, which give rise to expansion at sea, and adhere to the universal maxim, that in the absence of discord between the land and sea interests, the national strength is always a more or less active element of expansion at sea.

The principle maritime factors of national economy are emigration, exportation and maritime intercourse, to which, therefore, the investigation of the laws of motion are limited. Impressed with the insufficiency of our study of economy, though supported by the lessons of history, we present, with hesitation, the following fundamental principles on emigration, which might be designated simply as a scientific experiment.

1. Emigration over sea is the oldest, most persistent, and in its peculiarities, the most uniform, and therefore the strongest and most constant, of all the activities which determine the expansive capacity.

2. Without a corresponding emigration of enduring colonization, the phenomena of expansion almost always remain artificial and precarious, as is shown by the history of French colonzation.

3. The consequence of emigration depends upon many causes, the foremost of which are the number and quality of the emigrants, the character of the emigration, the bonds uniting them to the motherland and the defensive strength of the state.

4. The quality of the emigrants is more important than their number, in consequence of the predominating influence which it has upon the conquest of the markets.

5. Many colonies, particularly the Italian, in spite of the predominance of the number of emigrants, seem unsuited to exercise an influence commensurate with the quality of the emigrants.

6. Farmers and day laborers, viewed from unusual circumstances, are almost always lost to the mother country, because of their close union with the colony.

7. Professional and commercial men maintain for a longer period the reciprocal relations with the mother country, and form, therefore, the best foundation for colonization.

8. The intellectual attributes of emigrants are the most active, for the reason that agricultural colonial activity is little favorable to the development of the social and governing forces, on account of the enduring and violent conflicts aroused by emigration.

9. Should the emigrants be left to follow their own impulses, they may be regarded as lost, even though consisting of good elements, unless the state keeps them in check and defends them.

10. The state which is not solicitous about the direction and protection of emigration dissipates the national strength.

11. The direction must be exercised within the greatest limits beneficial to the state; the emigration must, therefore, be encouraged and kept moving within the limits of the economical growth of the nation, without weakening the political and military power of the state.

12. Since emigration must be kept, as far as possible, within the limits of national advantage, the emigration of the population must be so directed as to avoid dispersion, and its accumulation favored in such countries as permit the greatest permanence of the relations and activity of defence of the native land.

13. The protection of the state is indispensable, to keep the emigration within the national sphere of usefulness, and is the more necessary, the more the emigration is inclined to slip the bonds of reciprocal national relations. The country receiving such emigrants is weakened and disturbed by their influx.

14. All measures which aim at elevating the moral influence and actual activity of emigration, conduce to the advantage of the state; such measures, however, are rather inefficient without the continuous and immediate influence of merchant and naval fleets.

15. The social and physical influences emanating from the

nation's ships are almost always the most active elements of the defence and preservation of the colonies.

Having adduced the characteristics of emigration, and without asserting that the theme has been exhausted, we pass to the enumeration of the principles governing exportation. This constitutes the material phenomenon, which, co-operating with the living,—emigration—promotes the development of the national expansive capacity over sea.

Since the phenomena of emigration and exportation are almost similar and operate in the same direction, the principles previously adduced are generally applicable to one as to the other; we therefore limit ourselves here, to deducing certain principles which directly concern exportation.

1. Exportation is the most conspicuous indication of national expansion, whereas emigration, on the contrary, is the most eminent.

2. Exportation is a real activity of the economical expansive capacity only when its excess over importation represents an actual increase in the national prosperity and productive strength.

3. Exportation depending upon agricultural productions, while slower in conquering the markets, retains them much longer, and is, thus, an active element of permanent expansion.

4. Exportation which is based on industrial activity, penetrates the markets more quickly, but retains its position with difficulty unless directly favored by the state.

5. The support of the state is the more necessary, the less effective are the natural active elements of exportation, and the more menacing is the rivalry of other nations.

6. The protective system, in spite of the defects and mistakes incident to monopolies and exclusion, was, as history shows, most effective in maintaining the advantage in the national spheres of economy.

7. That protective system is the best, which aims to enlarge the expansive capacity of the state and to increase emigration and exportation, through the mutually operative functions of both these quantities.

8. Free trade always tends to injure those who lack the natural means of meeting free competition.

9. Free markets lead to an economical sophism whose consequence is the obstruction of the markets and the exhaustion of the small commercial nations to the advantage of the great.

10. The perturbations in equilibrium caused by free competition can only be fought by a protective tariff system or by a specialization of export productions.

11. The specialization of export productions diminishes the severity of competition; should the competition, however, not be a natural phenomenon, there is little hope of reaching it through economical measures.

12. The struggle of small commercial nations against the great, can only be carried on through the exercise of a powerful restraint upon the expansive functions, supported by the protection granted to markets and trade.

These principles lead to the conclusion that the increasing difficulty of competition, ever more menacing, can not be ameliorated without political protection. The latter was, and ever is, the simplest, most effective and quickest acting means of conquering and holding the markets.

(To be continued.)

[Translated by 1st Lieut. FRANK E. HARRIS, 3d Artillery.]

# PROFESSIONAL NOTES.

## DRILL REGULATIONS.

### Drill Regulations for Mountain Artillery.

Provisional.

Prepared for the use of the Cadets, U. S. Military Academy.

### SCHOOL OF THE CANNONEER.

1. The detachment consists of a gunner and five privates (six if there are two ammunition mules to the section).

2. The detachment forms in two ranks, two yards in rear of the trail of the piece umlimbered, facing towards it. This is the position of, "Detachment Rear."

**To tell of.**

3. Instructor commands: 1. *Call off*

Beginning with the gunner, the detachment calls of. The *gunner* is on the right of the detachment; *No.* 1 on the right of the rear rank; *No.* 2 in his front; *No.* 3 on the left of *No.* 1, and so on.

4. The front is that direction in which the muzzle points when unlimbered, or to which, when limbered, the mules heads are turned.

**Posts of Detachment, Piece Unlimbered.**

5. *Gunner* at left of point of trail.

*No.* 1 on line with breech, two feet outside right wheel.

*No.* 2 on line with breech, two feet outside left wheel.

*No.* 3 eight yards in rear of point of trail, at ammunition boxes.

*Nos.* 4, 5 and 6 with mules, 15 yards in rear of ammunition boxes, or under cover.

**To Post the Detachment at the Piece Unlimbered (From Detachment Rear).**

6. Instructor commands: 1. *Cannoneers to your posts*, 2. MARCH.

At the first command the gunner steps two paces to his front, faces to left, and commands: 1. *Right face to your posts.* He repeats command MARCH. At this command *Nos.* 1 *and* 2 execute column left, and take their posts; the other members break off to the rear aud proceed direct to their posts.

**To Reform the Detachment in Rear.**

7. Instructor (repeated by gunner) commands: 1. *Detachment rear*, 2. MARCH.

At the first command *Nos.* 1 and 2 face to the rear.

At the command *March* the cannoneers move and form, so that the center of the detachment will be 2 yards in rear of the trail of the piece.

**To move the Piece to the Front (or Rear) by Hand.**

8. To move the piece to front (or rear), the instructor commands: 1. *By hand to the front* (*or rear*), 2. *March*, 3 HALT. The *gunner* working at the trail, *Nos.* 1 and 2 at the wheels, move the piece to the front (or rear) until the command *Halt*, when all resume their posts.

**Service of the Piece.**

STORES REQUIRED.

9. Sponge and rod: on side of trail.

Gunners Haversack: on cheek of carriage.

Brake ropes.

SUMMARY OF DUTIES.

10. *Gunner.* Commands, sets the sight, points, and superintends the service of the ammunition.

*No.* 1. Mans right wheel, adjusts brake-rope, opens and closes breech and assists in pointing.

*No.* 2. Mans left wheel, adjusts brake rope, introduces ammunition into the bore, and fires piece.

*No.* 3. Keeps *No.* 2 supplied with ammunition.

*Nos*, 4, 5 and 6 attend mules.

TO LOAD AND FIRE.

11. To load by detail, the instructor commands: 1. *By detail*, 2. *Load*, 3. *Ready*, 4. FIRE.

12. To load without employing the method by detail, the instructor commands: 1. *Load*, 2. FIRE. The gunner repeats the command *Load* and commands *Ready* when the peice is pointed.

13. To discontinue firing, the instructor commands *Cease Firing.*

## *DUTIES OF CANNONEERS.*

### *Load.*

14. *Gunner.* Repeats command as to nature of projectile; sees that gun and equipments are in good order; receives sight from *No.* 2, inserts in it socket; kneels on right knee close to trail on left side; sets sight for indicated range; as soon as breech-block is closed, aims piece, working elevating screw with his right hand, and giving direction by turning the left wheel to fron tor rear; when piece is aimed raises both hands to indicate the fact; rises and resumes post.

*No.* 1. Adjusts brake rope: opens breech-block; closes it when cartridge has been inserted; assists gunner in aiming by holding right wheel steady, or turning it to front or rear; resumes post.

*No.* 2. Equips himself with haversack; adjusts brake-rope on left wheel; opens haversack, hands tangent sight to gunner, hangs lanyard around his neck; receives a cartridge from *No.* 3, enters it into the chamber, and with the thumb of left hand in side of mortice, pushes it home; resumes post and hooks a primer on the lanyard, holding it in his right hand.

*No.* 3. Carries cartridge to *No.* 2; obtains a fresh round from pack; resumes post. He moves at a run.

### *Ready.*

15. *Gunner* steps to left to clear wheels during recoil.

*No.* 2. Presses the primer into the vent, steps out so as to clear wheel, and takes post facing to front, lanyard held taut, the left hand pressing end against thigh, the right holding slide six inches from stop.

### *Fire.*

16. *No.* 2. Brings slide smartly against stop, so as to fire piece; throws lanyard over neck; in the event of a miss-fire, he places a new primer in the vent *from over the wheel*, and resumes the position of "Ready."

### *By hand to the front.*

17. After firing, *Gunner* commands: 1. *By hand to the front*, 2. *March*, 3. HALT.

The piece is run back to the firing position when gunner commands *Halt.*

After the command *Halt*, *No.* 1 steps up, throws the breech open smartly, thus ejecting the empty cartridge case; if piece is not to be loaded again immediately, closes breech.

*Cease Firing.*

18. *Gunner* removes sight passing it to *No.* 2.

*No.* 1. If the piece is loaded, opens breech gently, closing it after cartridge is removed; removes brake-rope and puts it up.

*No.* 2. Removes cartridge and hands it to *No.* 3; receives sight from gunner and puts it, with his lanyard, in haversack; removes brake-rope and puts it up.

*No.* 3. Returns loaded ammunition to the pack, and equalizes the ammunition in boxes.

**Firings.**

19. The commands and means prescribed in Drill Regulations for Light Artillery, Pars. 184 to 185, apply.

## SCHOOL OF THE DRIVER.

**Saddling.**

20. The pack saddle with its accessories, is placed in rear of mule, resting on ends of pad. In saddling at command, the driver stands to heel, two yards in rear of mule. A cannoner assists each driver; he stands to heel, one yard in rear of his driver. The mule is blinded.

**To Saddle.**

21. Instructor commands: *Saddle.* Driver folds blanket in four even folds and places blanket carefully on mule's back, being careful that the hair lies smoothly underneath, and that there are no wrinkles in the blanket. With the assistance of a cannoneer, lifts the saddle and places it on mule's back, a little in rear of the proper place; places crupper under the dock, and gently moves the saddle forward to position; cinches tightly with saddle-cincha.

Places cargo-cincha over saddle and secures it in place.

Removes blind and stands to heel.

**To Unsaddle.**

22. Instructor commands: *Unsaddle.*

The mule is blinded. Driver looses, and folds over top of saddle, both cargo and saddle cinchas. With assistance of cannoneer, slips saddle to rear, turns crupper over saddle, removes saddle and blanket, and places them on ground in rear of picket line, or on saddle peg in stable, blanket on top.

Removes blind and stands to heel

**Instruction of the Drivers of One or More Sections.**

23. Saddling is performed as described for a single driver.

In each section the gunner assists *No.* 3, *No.* 1 assists *No.* 4, and *No.* 2 assists *No.* 5.

**To Lead Out.**

24. Instructor commands: *Lead out.*

The mules are removed from the stalls or picket line and formed in column, the carriage mule in front, the gun mule next, the ammunition mule last. The distance between mules of the same section is one yard; between different sections, two yards. Chiefs of section take post opposite and near their leading mule, on the near side.

The detachment may then be conducted to the park, where at the command, *Detachments to your posts*, MARCH, the mules of each section are conducted to positions 23 yards in rear of their pieces, as in the "*order in battery*," and the cannoneers take their posts at the pieces.

25. On the dismissal of drill after parking the guns, the detachments are formed in column and marched to the picket line, or to the stable, where the mules are unsaddled as prescribed in Paragraph 22.

## GUN DRILL WITH MULES.

### Order in Battery.

26. *Gun Detachment.* At posts at piece (Par. 5); *Nos.* 4, 5, and 6 holding mules.

*Mules.* In line, 15 yards in rear of ammunition boxes, in order from right to left as follows: carriage mule, gun mule, ammunition mules. *No.* 4 holds both gun and carriages mules while *No.* 3 is assisting in the service of the piece.

*This is the "order in battery."*

### To Limber to the Front (for Packing).

27. Instructor commands: 1. *Dismount Gun*, 2. *Limber front.*

*Nos.* 3 and 4 bring up the carriage and gun mules at a trot to the gun; the ammunition mules are brought to the ammunition boxes. *No.* 3 places the carriage mule three yards in front of muzzle, facing the front. *No.* 4 places the gun mule three yards to the rear of the trail, facing to the rear.

GUN PACK.

28. The *Gunner* puts on the breech cover and semi-circular gun-pad.

*No.* 1 throws back the right cap square, puts on the muzzle cover, and grasps gun by maneuvring-handle.

*No.* 2 throws back the left cap square and grasps end of breech block. All being ready, the gunner, grasping the muzzle, commands, *Lift.* All lift the gun from the carriage and place it in its bearing on the gun saddle, breech in front.

*Nos.* 1 and 2 pass cargo-cincha over gun, trunnions passing through slot; cinch to belly-cincha.

*Nos.* 1 and 2, on their respective sides, then lift the axle while the gunner removes the wheels and replaces linch-pins and washers; *Nos.* 1 and 2 fasten them together with wheel strap, dish of wheels inside, and place them astride the gun, hubs between wheel-pads on cargo cincha, lower them to their proper position, and suspend them with the hub strap which passes around the hubs and over the top of the gun.

On most animals the best position for wheels is to have the distance from bottom of hub, measured over top of saddle, 36 inches.

*Nos.* 1 and 2 then buckle around the rim of wheel, on their respective sides, the two wheel-straps, which are attached to the belly-cincha chape, two spokes apart on each side, and tighten these straps until the wheels are in the best position, and bear firmly on the cargo-cincha wheel pads, and on the gun pad. The gun pack is then secured and can be easily adjusted from time to time to aid the animals on the march. If further security is required, lash the wheels, under corners of saddle pads and over and under the animal, and draw tight.

CARRIAGE PACK.

29. *No.* 1 places harness (in its sack) on near side, with pole-yoke under flap of harness-sack, and secures them in position with two straps which are attached to the saddle.

*No.* 2 places pole (butt end to front) and splinter-bar on off side, and secures them in position with the two straps which are attached to the saddle, passing the straps twice around the pole and bar. The front strap passes once in front and once in rear of the pintle-pin.

(Note. The harness, pole yoke and splinter-bar are not necessary to this pack, and the carriage packs equally well without them. If on the saddle they are to be left on it in coming into action).

The *Gunner* at the trail and *Nos.* 1 and 2 at the axle, at the oommand *Lift* from the gunner, lift the carriage and place it in position on the top of the saddle, bottom down, trail to the rear, so that special shapes of saddle arch-irons will engage in the carriage. The front arch-iron enters the slot just in rear of the carriage-axle.

*Nos.* 1 and 2 pass the cargo-cincha over the carriage, fhe wooden block down, and in between side flanges of trail, elevating-screw passing through hole in cincha and wooden block; they then place the emergency ammunition holder in position: cinch securely; *No.* 2 fastens gunner's haversack around gun carriage cheek, and this pack is complete.

AMMUNITION PACK.

30. *Nos.* 1 and 2 then put the ammunition boxes on the ammunition saddle. They put the upper ones up first, simultaneously, and strap them in place; then similarly with the lower ones.

*Nos.* 1 and 2 put the cargo-cincha in place and cinch it securely. The gunner then passes a lashing-rope around the iron handles on the ends of the boxes and over the pack, and the whole is securely fastened in place.

### Order of March.

31. The packing completed, the *gunner* commands, *Fall in;* when the detachment falls in, in column, as follows:

1°. Carriage mule, led by *No.* 3, on near side.

2°. Gun mule, led by *No.* 4, on near side.

3°. Ammunition mule, led by *No.* 5, on near side.

4°. 2nd Ammunition mule, led by *No.* 6, on near side.

There is a distance of *one yard* from hend to croup while in column.

The *Gunner* is near the right flank of the leading mule.

*Nos.* 1 and 2 are similarly placed with respect to second and third mules. *This is the "order of march."*

### To prepare for Action.

32. Instructor commands: 1. *Action Front* (or *Right*, or *Left*, or *Rear*).

CARRIAGE PACK.

*No.* 1 hastens to near side of carriage mule; *No.* 2 to off side. *No.* 1 uncinches cargo-cincha, and assisted by *No.* 2 slips it forward on mule's neck.

*Gunner*, at trail, commands, *Lift*, and, assisted by *Nos.* 1 and 2 at axle ends, lifts carriage and places it on ground, its front in direction designated in command.

GUN PACK.

33. *No.* 4 unstraps wheels, and, as soon as wheels are removed, uncinches cargo-cincha and slips it to front.

*Nos.* 1 and 2 remove wheels; disengage small wheel strap, passing same to *No.* 4, who fastens this, and the hub straps, to saddle.

*Nos.* 1 and 2 take wheels to carriage, turn them over to *gunner*, lift carriage while gunner puts wheels on.

The *gunner* at the muzzle, *Nos.* 1 and 2 at the breech, at gunners command *Lift*, remove gun and mount it on carriage.

*Gunner* removes breech cover and gun pad, placing them on ground to right of piece.

*No.* 1 removes muzzle cover and places it with breech cover.

AMMUNITION PACK.

34. *No.* 5 uncinches cargo-cincha, removes and places on ground one

ammunition box from each side. *In action right, left*, or *rear*, *No.* 5 before uncinching cargo-cincha takes mule to point 8 yards in rear of trail of piece.

35. As soon as packs are removed from mules, *Nos.* 3, 4, and 5 secure cargo-cinchas on saddle, and move mules to posts, 15 yards in rear of ammunition boxes; or to a position under cover, if so directed.

All take posts as in the "*order in battery*."

### Mule Draught.

36. *Equipment.* Both pole and splinter-bar (*double draught*), and shafts (*single draught*) are provided.

The former would be carried where pack transportation only is ordinarily possible, since the shafts are too unwieldy to pack.

The pole and splinter-bar are on the off side of carriage-pack.

The harness on near side.

#### TO LIMBER FOR DRAUGHT.

37. Instructor commands: 1. *Double Draught*, 2. *Limber Front* (*Rear*, *Right*, or *Left*).

*Gunner* has trail pointed in direction indicated in command.

*Nos.* 3 add 4 bring their mules up at a trot; carriage mule is the near mule, gun mule the off mule in draught.

*Nos.* 1 and 2 procure the harness. *No.* 1 harnesses the near mule; *No.* 2 the off.

*Gunner* procures pole and splinter-bar, assisted by *No.* 3 puts splinter-bar and pole in position. *No.* 4 holds *No.* 3's mule while this is being done.

*No.* 5 leads mule at trot to ammunition boxes; *Nos.* 1 and 2 put boxes in place, and fasten cargo-cincha. *No.* 5 takes post two yards in rear of piece.

38. Marching in double draught, *Nos.* 3 and 4 are near the heads of their mules. The ammunition mules follow two yards in rear of piece.

The *Gunner* marches opposite the trail, *No.* 1 opposite the muzzle, on the near side.

*No.* 2 opposite the muzzle, on the off side.

All one yard outside the wheels.

#### TO UNLIMBER AND PREPARE FOR FIRING.

39. Instructor commands: 1. *Action Front* (*Right*, *Left*, or *Rear*). *Gunner* unhooks splinter-bar and places it over pack saddles.

*No.* 4, unstraps pole-yoke from pole.

*Gunner* supports pole, while *Nos.* 3 and 4 move mules forward, out of draught.

*Gunner*, assisted by *Nos.* 1 and 2, removes pole, places it to one side, turns muzzle of piece in direction designated in command.

All take post as in the *order in battery*.

40. To limber for draught again, the mules being harnessed, the command is as in Paragraph 37. The pole and splinter-bar are adjusted by the *Gunner*, *Nos.* 1 and 2; the mules are brought up and hooked in.

41. To discontinue traction by draught, while in the "order in battery" or limbered for draught, the instructor commands: *Unharness*.

*Gunner* and *No.* 3 remove pole and splinter-bar.

*Nos.* 1 and 2 remove harness and place it in harness sack.

Harness, pole, and splinter-bar are placed to one side.

All take post as in the "order in battery."

1st Lieutenant WILLIAM LASSITER, 1st Artillery.

## ARTILLERY MATERIAL.

### Terni Armor.

We have received data of some remarkable plates made at Terni, and tested at Muggiano near Spezia. The plates are now exhibited in the Paris Exhibition.

The result which is most valuable for general purposes is naturally the one most severely tested, and that is a "Terni special" type of plate, whose dimensions were 7 feet 10½ inches by 5 feet 3 inches by 5.9 inches. This was attacked, as shown in the table herewith.

It will be seen that as regards penetration the quality of the plate is as nearly as possible the same as that of a good Krupp process plate. The point of the projectile just gets through when the figure of merit reaches 2.93; that is to say, when the thickness of wrought iron that would be perforated by Tresidder's formula is nearly three times the actual thickness of the plate. The plate face is, however, remarkable in showing no cracks or scaling off round the point of impact. There can be no question that this is a remarkable result. It was obtained on May 3rd last year. There are records of excellent results obtained subsequently, but none where the plate seems to have been tested so severely as this one. There are plates with harder faces which show scaling, and in one case in 1896 considerable cracking, as one would expect. These are classed "Terni breveté." There are four of this kind, termed "Terni special," which are qnite free from cracks and almost free from scaling. Of this quality of plate we think we are sure to hear more before long.

—*The Engineer*, July 6, 1900.

| Number of round. | Projectile. Calibre. | Projectile. Weight. | Projectile. Nature. | Striking velocity. | Thickness of iron which would be perforated by Tresider's formula. | Fig. of merit of relation of wrought iron to actual thickness of plate. | Effect of blow. On the plate. Penetration. | Effect of blow. On the plate. Other effects. | Effect of blow. On the projectiles. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 in. | 45.4 kg. 99.6 lb. | Krupp rupture shell | 590 m. 1936 f.s. | in. 13.3 | in. 2.25 | in. 4.32 | Plate not perforated, no cracks | Broken up, leaving the points lodged |
| 2 | " | | | | | | 4.13 | do. | do. |
| 3 | " | | | | | | not measured | do. The point of No. 1 round here dropped out. | do. |
| 4 | " | | | | | | do. | No perforation, the point of No. 2 round dropped out. | do. |
| 5 | " | | | 705 m. 2313 f.s. | 17.2 | 2.93 | do. | No perforation, no cracks. | do. |
| 6 | " | | | | | | 13.8 | The projectile point entered the backing, no cracks. | do. |

## RANGE AND POSITION FINDING.

Range Table for 10″ B.L.R. when fired with the Parrott projectile, weight 275 pounds, and charge of 85 pounds, sphero-hexagonal powder. I. V. 1532 f.s.

Computed by 1st Lieut. Alfred M. Hunter, and 2d Lieut. J. C. Goodfellow, 4th Artillery.

| Range. yds. | Angle of Departure. $\varphi$ | Value of one minute in yards of range. | Range Correction. | | | Deviation Correction. | | Time of flight. | Angle of fall. | Maximum Ordinate. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | ± 10 f.s. I. V. | $\pm\frac{\Delta C}{\delta}$ $.01\frac{\ }{\delta}$ | Wind one mile per hour. | Drift. | One mile wind. | | | |
| | | | yards. | yards. | yards. | yards. | yards. | | | |
| 3600 | 6 2.0 | 7.6 | 31.95 | 8.66 | 1.08 | 9.0 | .60 | 8.99 | 7 52.6 | 332.7 |
| 3700 | 6 15.2 | 7.5 | 32.41 | 9.02 | 1.13 | 9.65 | .64 | 9.39 | 8 11.8 | 354.2 |
| 3800 | 6 28.6 | 7.4 | 32.86 | 9.38 | 1.18 | 10.31 | .68 | 9.60 | 8 32.8 | 376.8 |
| 3900 | 6 42.3 | 7.3 | 33.30 | 9.75 | 1.23 | 11.05 | .72 | 9.90 | 8 50.7 | 403.9 |
| 4000 | 6 56.0 | 7.1 | 33.73 | 10.11 | 1.27 | 11.80 | .76 | 10.21 | 9 13.9 | 429.2 |
| 4100 | 7 10.0 | 7.0 | 34.15 | 10.47 | 1.32 | 12.57 | .81 | 10.52 | 9 32.1 | 456.0 |
| 4200 | 7 24.0 | 6.9 | 34.66 | 10.83 | 1.37 | 13.37 | .85 | 10.83 | 9 52.7 | 485.0 |
| 4300 | 7 38.6 | 6.8 | 35.06 | 11.19 | 1.42 | 14.41 | .89 | 11.14 | 10 14.8 | 512.8 |
| 4400 | 7 53.2 | 6.7 | 35.45 | 11.56 | 1.47 | 15.09 | .94 | 11.46 | 10 35.1 | 542.3 |
| 4500 | 8 8.1 | 6.7 | 35.85 | 11.92 | 1.54 | 16.00 | .99 | 11.73 | 10 57.1 | 573.6 |
| 4600 | 8 23.2 | 6.6 | 36.20 | 12.28 | 1.60 | 16.95 | 1.04 | 12.11 | 11 20.7 | 607.4 |
| 4700 | 8 38.6 | 6.5 | 36.56 | 12.64 | 1.66 | 17.93 | 1.09 | 12.45 | 11 40.9 | 638.3 |
| 4800 | 8 54.0 | 6.4 | 36.98 | 13.00 | 1.71 | 18.95 | 1.14 | 12.76 | 12 3.4 | 673.0 |
| 4900 | 9 9.8 | 6.3 | 37.25 | 13.36 | 1.78 | 20.00 | 1.19 | 13.09 | 12 26.6 | 705.0 |
| 5000 | 9 25.9 | 6.2 | 37.55 | 13.73 | 1.86 | 21.07 | 1.25 | 13.43 | 12 48.5 | 741.6 |

| Range. yds. | Remaining Velocity. |
|---|---|
| 3600 | 1017.8 |
| 3700 | 1010.8 |
| 3800 | 1002.8 |
| 3900 | 996.4 |
| 4000 | 990.3 |
| 4100 | 984.0 |
| 4200 | 977.8 |
| 4300 | 971.8 |
| 4400 | 965.6 |
| 4500 | 959.6 |
| 4600 | 955.5 |
| 4700 | 948.5 |
| 4800 | 943.1 |
| 4900 | 937.2 |
| 5000 | 932.5 |

NOTE. This table was computed with the latest tables of Major Ingalls. As the coefficient of reduction for this obsolete projectile is unknown, it is believed that in practice considerably greater elevations than those given in the table will be required.

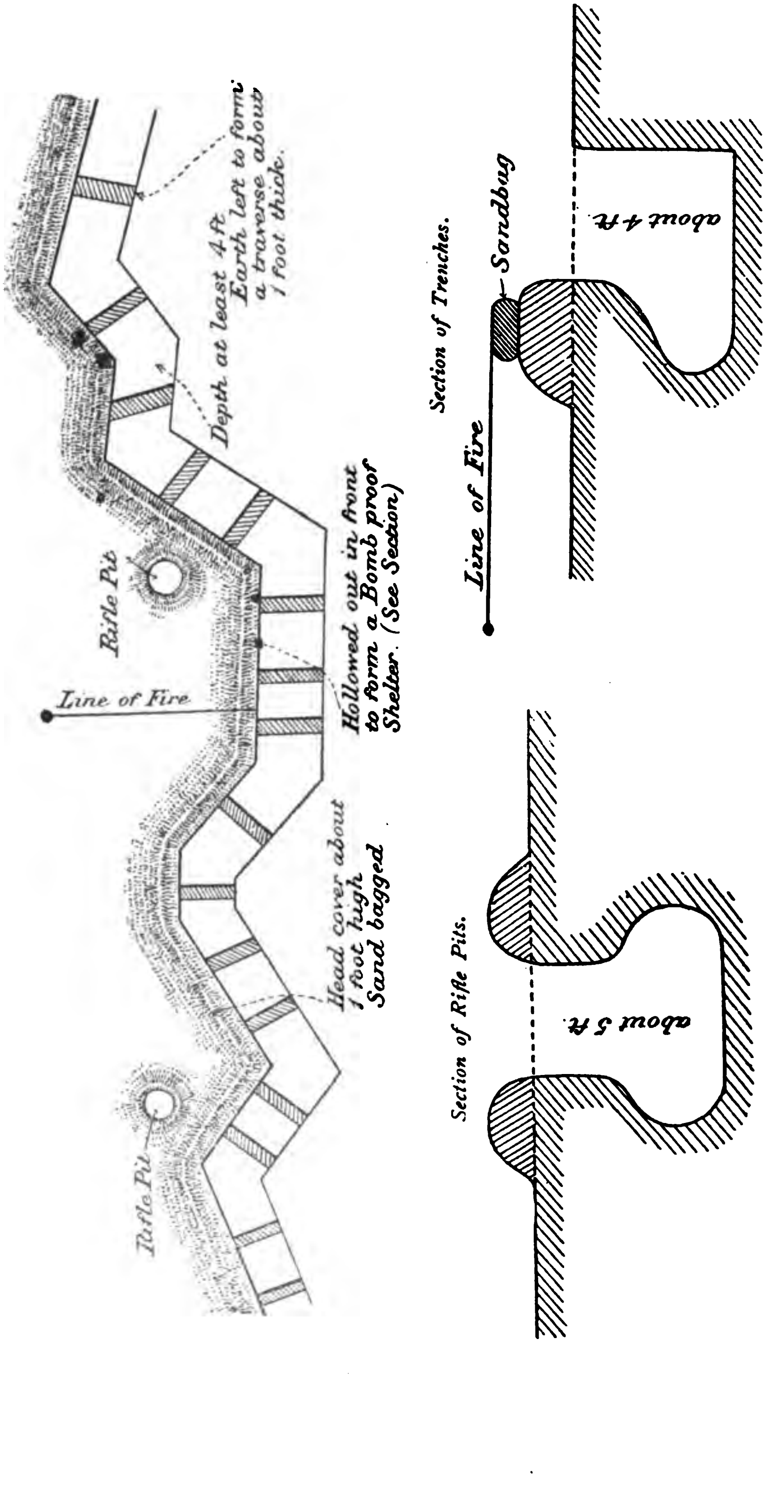
## FORTIFICATIONS.

### Boer Trenches at Paardeberg.

We are able, through the courtesy of the Editor of the *Royal Engineers Journal*, to publish the following description and illustrations of the Boer trenches at Paardeberg.

"The following is an extract from a letter received by Major-General E. H. Courtney, R. E., from his son, Captain E. A. W. Courtney, A. S. C. :—

"The Boer trenches are marvellous, and a real lesson to us; *our* rotten




BOER TRENCHES AT PAARDEBERG.—*Jour. Royal Unit. Serv. Inst.*

little scooped-out affairs, a foot or so deep, in one long line, always open to enfilade, look child's play to theirs; theirs are *at least* 4 feet deep, hollowed out in front below ground with good head cover, and sandbagged; also, each trench (so to speak) can only hold three men, then a traverse of earth comes, *a foot thick*, and the trenches are *never* in one straight line. I give you a bird's-eye view, looking down on them from above (see plan). Of course, this is only a rough diagram, but I know it will interest you, more especially because these trenches are the talk of the whole army; and I *hope* we shall take a lesson!

"I give you also a section of the Boer trenches, and you will see their ingenious arrangement for getting out of shell fire! No wonder they only had fifty killed out of all that furious bombardment! When you think Cronje's force was at best but 6,000, and that he had only two days to entrench himself in, I think you will consider it the marvel we all do!"

—*Journal Royal United Service Institution*, May 15th, 1900.

## MILITARY GEOGRAPHY.

### Submarine Cables in Peace and War.

The operations now going on in South Africa have probably brought home to most of us, more forcibly than was ever the case before, the immense importance of that system which, having its centre in England, embraces the whole globe in a vast network of ocean cables. The troops are acting at a distance of 6,000 miles from our shores, yet, day by day, when there is no intervention of the censorship, we are kept informed of the proceedings with almost as much ease and. minuteness as if the operations were taking place in the Long Valley at Aldershot. So that it may fairly be regarded as a matter of self-congratulation that this great undertaking was established by English enterprise, that the necessary funds were provided by English capital, and that the whole system is practically under the control of the English Government.

The cables, indeed, are in no sense Government property, except that in certain cases, where the value is clearly more strategic than commercial, a certain subvention is made from the public funds. But in granting the concessions which permitted the construction of the several cables, Parliment has so fettered the action of the Companies by salutary restrictions that the cables at periords of crisis are as much at the disposal of Government as if they had been paid for in the first instance out of the public purse. It is provided, for instance, that Government messages should have precedence over those of the general public; that no employé of foreign nationality should be allowed upon the staff; that in time of war the Government should be at liberty to substitute its own people for the regular staff, and so forth.

The pecuniary benefits resulting from a commercial monopoly such as this are sufficiently obvious. As has been well said by a foreign critic, by means of cables England renders all other nations tributary to her. And the political advantages are not less marked than the commercial, for the possession of the cables affords the opportunity of acquiring early and exclusive information of events happening all over the world, information which now and again may be of the highest value.

But if the control of the world's ocean cables is an important matter in time of peace, its significance is increased tenfold in case of war, and more particularly in the case of a naval war, and this fact is becoming very

generally recognized. Not long since the American "*Boston Globe*" made the following remarks upon the subject:—"Of all the lessons that the United States ought to be learning from the Transvaal War the chiefest is that any nation aspiring to be a first-class Sea Power in the coming twentieth century must control the submarine cables as well as the Fleets. Why does Britain rule the waves to-day? Is it alone because she owns the biggest fleets, or is it because, owning the bulk of the submarine cables of the world, it makes every British battleship worth five ships of the enemy who is destitute of them? The Power that is to rule the waves must rule the cables. If England is master of the seas it is largely because of her great silent Empire under the seas."

In any naval plan of campaign directed against this country, some scheme for cutting the more important cables must necessarily find a place. In a work published in France under the title of "La Guerre Navale avec l'Angleterre," which was recently discussed in these columns, the author considered that with the aid of ships furnished with the necessary special appliances for cable-raising, the operation, though one of some delicacy, would not be very difficult. A German officer, Major Otto Wachs, who has also been writing at some length upon the same subject, and whose paper, translated by a young French naval officer, was published in a recent number of the *Revue Maritime*, takes a less optimistic view of the subject. Major Wachs is of opinion that although the International Conference of 1882, which fixed the inviolability of the cables in peace time, permits them to be cut in time of war, the task of raising and cutting the cables would be found a somewhat difficult one in practice, partly because operations would be forbidden by international law in the neighborhood of a neutral coast. For the difficulty both of finding and of raising the cable would be obviously very greatly increased by the additional depth of water in the open sea. Some of the Major's concluding remarks are perhaps worthy of reproduction. "It seems a remarkable example of the irony of fate," he writes, "that this England—at whose feebleness everyone makes merry—has succeeded, not as the result of a happy stroke of luck, but as the merited reward of a great work peacefully accomplished, in encircling the world by means of her cables, and making the entire globe her tributary, for not only does she throw every obstacle in the way of other nations who attempt any great enterprise, political or commercial, but contrives to make them pay the interest of the capital embarked in submarine cables, while she has created at their expense an admirable instrument of power in the event of international complications destined to find a solution in war. If we listen with a smile to the story of their desperate efforts to maintain supremacy, by building a fleet of the first class, made up of superb vessels, for which they have neither officers of experience, engineers, or sailors, one cannot refuse one's admiration to this gigantic work, which consists in establishing submarine cables, for transmitting from distant stations, thanks to such centres as Malta, the Azores, Bermuda or Seychelles, to headquarters in London, swift messages, commercial, military or maritime, which are only communicated later to other Powers interested."

It may be remarked in passing that the taunt here levelled at us that in the development of our Fleet the *personnel* has failed to keep pace with the *matériel*, has some basis of fact. We have, indeed, provided ourselves with a number of the most up-to-date powerful vessels, while still lacking an adequate supply of crews to man or of officers to command them.

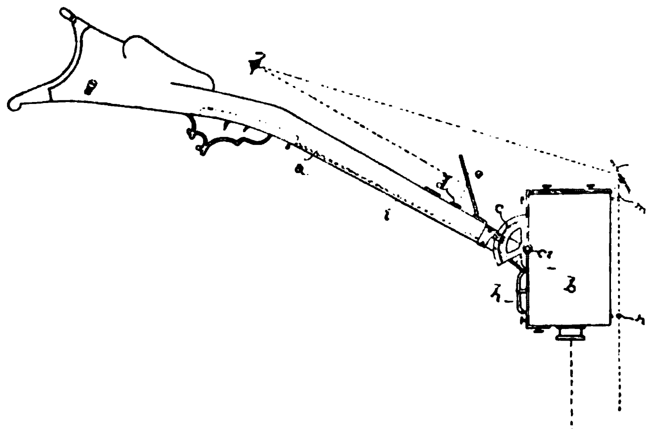
Such a state of things, unsatisfactory and anomalous as it appears, is to some extent unavoidable, since, while it is possible by working over-time in the Government Yards, and by putting pressure on the private contractors, to turn out new battleships and cruisers in what is a relatively short period of time, the training of the sailors, and still more so of the officers, must always be a matter of several years. As was said by Admiral von Tirpitz the other day during the debate on the New Navy Budget in the German Reichstag, "We cannot conjure up officers and seamen for the additional ships by a stamp of the foot." The entries of officers, both of the executive and engineer classes, have been largely augmented of late years, and we are already beginning to reap the advantage of this policy, while the number of seaman is also each year becoming more nearly adequate to the increased needs of the Fleet. Meanwhile, in the practical monopoly of the world's cable system, this country possesses an asset which is admitted on all sides to be of the very greatest value. It rests with the authorities, and more particularly with the department specially charged with the supervision of all matters relating to the ocean cables, to see that no precaution is omitted which would ensure their integrity and efficiency in the unfortunate event of the outbreak of a naval war.

—*United Service Gazette*, May 26, 1900.

## AERONAUTICS.

### Photogrammetric Apparatus for Balloons.

The methods for accurate photography to scale from balloons have labored under the disadvantage that the angle of the axis of the camera with the horizontal or vertical plane is not known. This is due mainly to the movements of the balloon, but even if freely suspended the apparatus would not take a constant position, due to the varying resistance to the air.



The apparatus here represented permits of photographing under a fixed angle, thus greatly simplifying this method of topographical surveying.

In external form it resembles a rifle, which is similarly held against the shoulder. At the forward end of the shaft *a* is attached, at a known angle (which may be varied at will), a photographic camera *b*. The latter revolves about a pivot $c^1$, and by means of the arc *c* can be set at any desirable (and then *known*) angle.

At *d* is a level, the bubble of which is seen by reflection in the folding mirror *e*. The instantaneous shutter *h* is connected with a cord *i* in the shaft to the trigger.

To use this apparatus it is first directed on the landscape to be photographed by means of the sights *m* and *n*, reflected to the eye by the mirror *o*; the angle on the arc *c* is noted and fixed. Then the bubble of the level is

brought to the middle point and the trigger is pulled. All the data for accurate photogrammetric work are thus obtained, and much unnecessary calculation avoided. Indeed, if all the photographs of a region are made at the same angle, they can be placed together on the chart to make a map of the region to scale.

—*Illustrirte Aëronautische Mittheilungen*, July.

## TRANSPORTATION.

### Armored Train for South Africa.

An inspection and trial of the armored engine and carriages of J. Fowler and Co., of Leeds, took place on the morning of Wednesday, May 16th, at Leeds. As many of our readers will remember, this firm has already sent about thirty-five engines and trains—unarmored—to South Africa for use in the war. They will also understand that we are not now speaking of engines and rolling stock for railways to which armor plates have been applied, and concerning which we have heard a good deal both in the late war in Egypt and in the present war in South Africa. The engines and trains of J. Fowler and Co. are for road traffic, and, indeed, for moving over any fairly hard ground. A number of these, as already said, were sent to South Africa early in this year, and have been reported to have done admirable service. Some of them—seven, we think—were with Sir R. Buller. Nothing circumstantial

however, has come to hand as yet. Before speaking of the day's work, it may be desirable to say a few words as to the part played by road and traction engines in operations of war and where they have been actually tried.

Some twenty years ago J. Fowler and Co. had supplied to Herr Joepffer, of Hamburg, some large engines—perhaps 25 per cent. heavier than those now before us—for ploughing, whose intended use was prevented by the Franco-German war of 1870-71. The owner, however, being a man of enterprise, conceived the idea that they would fulfil important functions in the war, and called on Von Moltke, who heard what he had to say, and directed an officer to inspect them, test their powers, and report. This ended with their being taken into the service, one of them eventually reaching Paris. What valuable work was done may be seen by the following incident. The Germans found that about fifteen miles of a French line had been destroyed and the rails removed. This was obviously the very case in which traction engines would be invaluable to bridge the gap until new rails could be laid down. On the far side, however, were no engines, for, as may be supposed, the French were not likely to leave them. Herr Joepffer, who had been appointed officially over the branch of work he had initiated, expressed confidence that if a truck could be found capable of carrying a locomotive, his engine could draw it across the fifteen-mile interval. Eventually two trucks were discovered capable of carrying locomotives, and thus locomotives were successfully transferred on to the French line. The great value of this is too apparent to need further comment; it is, however, an exceptional incident, because generally rails are not carried far away, and are easily replaced. The more general work of the Fowler engines would be to travel over ground where no railroad has ever been made, and this affords unlimited scope. It is surprising also over what very unpromising country the engines can work if rightly handled. Over fairly hard ground the engine can draw its load in the normal manner, but terrible breaks and ugly bits have to be provided for. For example, we may encounter soft mud with not much bottom, when the wheels turn round without moving forward. To meet this the tires are drilled to take short flanged pieces called "spuds"—which are fitted across them like paddles—one end hooking over the wheel edge, and the other secured by means of a hole drilled through the tire. Over bottomless sand it is necessary to use planks, and often it may be necessary to let the engine go out without its load, when it has wonderful power of getting through, and then employing it to haul the load from a fixed position, for which work it is provided with wire rope wound on to a drum carried on the wheel axle, and contrived to be driven at will instead of the driving wheels, so that the engine becomes stationary and draws the load.

Two engines may also be employed to help each other through a difficulty. A notable example of this occurred in Spain some years ago, when Messrs. Fowler's representative was forbidden to use a bridge. He fixed a block on a tree on the far side of the river, and used one of two engines to haul the other through the river. As there was about 6 feet depth of water, it is obvious that each engine's own fires must be extinguished and leave it in the river if it depended on its own powers. In fact, it may be seen that the engines may be likened to elephants, their function being to draw loads over open ground, and to be cleverly applied to overcome special difficulties. Elephants, however, have the peculiar characteristic of objecting to being brought under fire, an objection that they have consistently maintained since the days of Pyrrhus' defeat by the fire balls employed by Curius Dentatus.

The simile, then, holds good most completely in the case of the engines we have spoken of as hitherto supplied to the Germans and ourselves, but with modification to the armored train with which we have now to deal. Although it is by no means intended to bring this train under fire more than necessary, it is clear that it is very difficult to defend a line of communication near an enemy so completely that a sudden approach may not be made, especially by infantry, who can conceal themselves and lie in wait much more easily than artillery. Consequently, it is clearly an advantage to have protection against infantry fire. How far it is desirable to sacrifice mobility by adding the necessary weight depends on circumstances. We are inclined to question if a train running on rails should be armored. The protection is only needed when an enemy approaches the railway, and we think, when this is feasible, the enemy might generally place explosives on the line, which would destroy the train much more effectually than firing at it with small arms. Lines of communication ought surely to be sufficiently well guarded to ensure the safety of railroads on which the supply of the troops depends. Road engines are under different conditions; they may well be employed nearer to the enemy than those on lines of rails, and running, as they may, across open ground, it would be much more difficult to set an explosive trap for them. While we think, then, that they ought not generally to be exposed to the risk of infantry fire attack, it is a contingency to contemplate, and the question appears to be, Is it worth while carrying armor in order to push our road engines and trains over ground where they may be exposed to musketry fire? This question appears to have been answered in the affirmative by our authorities, and we do not doubt that they are right as to a certain proportion of the number of trains supplied, and certainly the number is not likely to be exceeded now, for the pair of engines and trains now before us are the first armored road trains turned out. The armor consists of Krupp-process steel, a quarter of an inch thick when used vertically, and three-sixteenths when inclined.

The following description has been furnished by the manufacturers:—Each train consists of a special road locomotive and three or four wagons, all armored with special steel bullet-proof plates, tested to withstand rifle fire at 20 yards range, or splinters from shells. Each vehicle is intended to carry one 5-inch or 6-inch howitzer on its carriage and a 4.7-inch naval gun arranged for the same carriage as the howitzer; they can also be used for carrying ammunition, stores, and men. The train is designed to travel at various speeds from two to six miles per hour: it is fitted with a special arrangement of winding forward drum and steel cable, which enables it to cross spruits and other difficult soft or steep places by winding, should the train be unable to travel direct.

It was essential in designing the engines that all vital parts should be protected, at the same time not to interfere in any way with the easy manipulation of the engine by the driver and steersman. Special attention has been given to the boiler blowing off, washing out and cleaning, lubricating the working parts of the engine, the use of the winding forward drum and the proper paying out of the cable, &c. These arrangements have necessitated a special construction throughout. The problem of supporting the armor from the boiler—at the same time making it easily removable—was difficult, but it has been successfully dealt with.

The engine is of the compound spring-mounted type, specially designed and built to carry armor. The armor is arranged to be easily dismounted,

and the engine would then be similar to the army service type, many of which are now successfully in use in South Africa. The boiler is constructed to work at a pressure of 180 pounds per square inch. The power is transmitted from the crank shaft to the hind axle by a train of cast steel gearing, with a self-acting differential gear on the main axle. The ratio of the gear is such that a speed of 1½ to 3 miles per hour is made in slow gear, about 2¼ to 4½ miles per hour in middle gear, and about 6 to 8 miles per hour in the fast gear. These speeds are increased by running the engine faster. The water tanks are sufficient for a run of from 10 to 17 miles, according to the load and conditions of roads. All parts of the engine, except the road wheels are protected by armor from rifle fire, and all levers, cocks, and lubricators are arranged so that they can be manipulated from the foot-plate. The driving wheels are of special construction, 7 feet diameter and 24 inches wide, having tee section strips for giving increased adhesion on the veldt and on sand tracks. The armor is of bullet-proof plates manufactured by C. Cammell and Co., of Sheffield, and every plate has been tested under fire by the War-office officials. All the armor-plates have further been tested under rifle fire at C. Cammell and Co.'s works, at 20 yards range, point blank, with Lee-Metford and Mauser shot. Look-out holes are formed in the cab in convenient positions for the driver and steersman, and these are provided with special shutters designed by Captain Nugent, R.E. The engine is mounted entirely on laminated springs, with an arrangement of suspending levers, &c., patented by John Fowler and Co., which enables a high speed to be maintained over rough ground without in any degree affecting the true working of the driving gear, at the same time giving sufficient cushion to obviate almost entirely the shocks which are given to a traction engine when traveling over rough country. Without this spring gear the armoring could not have been successfully done.

The wagons are intended to be used two or four in train. The general design was prepared by the War-office, as also were the details connected with protection against bullets. The main frame is constructed entirely of steel scantlings with an arrangement of springs, which give sufficient elasticity to enable the wagons to ride steadily when traveling on rough ground. The wheels are specially built with hard steel tires 12-inch wide, and the hind wheels have a wide gauge to give the utmost stability to the vehicle; the front wheels are narrow in gauge to allow for turning corners with precision and safety. Each wagon is provided with brake gear, arranged to work outside from either side of the wagon, and also from the inside when required. A spring coupling-bar is provided for overy wagon, also suitable coupling arrangements at the tail end, either for yoking up to another or engaging with the trail-eye of a howitzer. These are fitted with the usual safety pins, as used in artillery practice. A pair of incline ramps are carried on each wagon; these are intended to form an incline to facilitate the loading of guns, &c. The wagon bodies are built of special bullet-proof steel, manufactured by Charles Cammell and Co., with adjustable shutters to the sight-holes, so that a very small opening can be left for sighting purposes or a larger opening can be left for sighting and firing a rifle, or these shutters can be suspended to give a full opening. The lower part of the body is made a fixture to the frame, partly at an angle. The upper part is formed of three hinged flaps on each side made to fix up when required, the clamping arrangements being suitable for securing the flaps when up and locking them together when down, the flaps then forming ridge-shaped covers. When the

sides are fixed up the wagon gives accommodation for thirty men, or for the carriage of a howitzer, ammunition boxes, &c., as required. The loop-holes enable the men to observe what is taking place, and if necessary the openings can be used as sight-holes for rifle firing. When the sides are down the wagon is proof against rifle fire or rain, and can be used for ammunition or other stores. Large doors in four parts are hung at the back end of the wagon to facilitate loading. The body is supported by steel arch ribs, to which the side flaps are fixed when up, and from which check ropes are suspended to support the flap doors when down. Fixed and movable seats are placed in the wagon; the latter are let down when the wagon is used for the carriage of guns, &c.

To this may be added that the train will travel from thirty to forty miles a day on fairly good roads, that the engine is nominally 10 horse-power, practically greatly in excess of this. It is made to burn either coke, coal, or wood. It uses about 7 cwt. of coal for thirty miles. It carries 430 gallons of water, and generally needs a fresh supply after running about twelve miles. The engine track is about 8 feet 6 inches wide. It will draw about 40 tons behind the engine, and will climb a gradient of 1 in 10. The armored sides of the trucks when fully open lean inward at an angle of about 20 degrees with the vertical. It would be inconvenient for men sitting on the seats running along the sides if this were exceeded. When carrying ammunition, however, or any load of small bulk compared to its weight, the plates, which are hinged along the bottom edge, are lowered so as to meet on the centre line, forming a complete roof, the protective power being thus greatly increased, the angle of this sloping roof being about 60 degrees with the vertical, or 30 degrees with the horizontal.

On this trial being satisfactory the War-office will dispatch the pair of trains to South Africa without delay, and we do not doubt that a satisfactory report was made. The train, consisting of an engine, three trucks, and two 6-inch howitzers, was run on the road to Methley. The front howitzer had its trail-eye attached to the hook in the rear of the third wagon, while the second howitzer trail-eye was attached to a hook fixed for this purpose on the breast of the front howitzer carriage, which is an addition to the usual fittings of the carriage. The steepest incline met with on the road was 1 in 11, which presented no sort of difficulty, and on a hill of nearly this gradient the train was halted and started again. The running and turning appeared quite satisfactory. In short, John Fowler and Co, may be congratulated on successfully making a form of war engine which we think has an important future. To Captain Nugent, R.E., we believe, the credit is due for shaping the form taken by some of the features.

—*The Engineer*, May 18, 1900.

# BOOK REVIEWS.

**A French-English Military Technical Dictionary by Cornélis De Witt Wilcox, First Lieutenant of Artillery, United States Army. No. XXIV, Part II, Espace-Palan. War Department. Adjutant-General's Office. 1900. Washington. Government Printing Office. Pp. 144.**

The continuation of this valuable work is similar in contents and character to the first part issued in the summer of 1899, and the remarks made by us in reviewing that part apply with equal force to Part II, comprising the words from *Espace* to *Palan*, and thus nearly completing the work.

The action of the War Department in Publishing this work cannot be too highly commended, as it shows a full appreciation of the value of a military dictionary to the officers of the army, and encourages study of the military literature of a great foreign nation. Without a good military dictionary containing the mass of new words recently introduced such study is well-nigh impossible, especially in such branches as tactics and artillery.

J. P. W.

**The Naval Annual, 1900. Edited by John Leyland. Portsmouth: J. Griffin & Co., 2, The Hard.**

This excellent anuual is deprived of its editor of many years past by the fact that the latter has been appointed to raise and take command of the Sussex Company of Imperial Yeomanry for service in South Africa. The present editor was selected by Mr. Brassey to conduct the work this year and he has ably performed this duty.

The volume is similar in character and arrangement to the previous volumes, although there are several new contributors.

Among the articles of especial interest to us may be mentioned the chapter on Naval Brigade, in which the combined use of navy and army is incidentally discussed, and the articles on Armor and Ordnance. The volume also contains the text of the new German Naval Bill in full. The lists of ships of the different natons is as complete and accurate as usual.

The *Annual* has been for many years indispensable to the navy officer and the coast artilleryman, and has kept pace with the development of the recent interest in expansion and sea-power. Its scope, completeness and accuracy are a credit to the editors, and they have been ably seconded by the publishers.

J. P. W.

**Der Krieg in Sudafrika. von Kunowski, Hauptmann, und Fretzdorff, Oberlieutenant. Leipzig: Zuckschwerdt & Co. 1900. Parts I and II. Pp. 120.**

Captain Kunowski and First Lieutenant Fretzdorff of the German army here present an account of the War in South Africa, based on the best available sources.

After a brief summary of the origin of the Boer Republics and the causes which led to the war, followed by a short outline of the military geography of the theatre of war, the authors take up the campaign proper, opening the account with a sketch of the forces of the two contending powers.

The subject-matter of the operations falls naturally into the following sections:

1. The campaign in Natal to the end of October.
2. Events in the north, the west and the central theatres.
3. The transportation of the army corps and its deployment.
4. Lord Methuen's advance to relieve Ladysmith.
5. The operations of Generals French and Gatacre.
6. General Buller's first attempt to relieve Ladysmith.
7. The mobilization of British reintorcements.
8. Events on the southern and western theatres.
9. The second attempt to relieve Ladysmith.
10. The third attempt to relieve Ladysmith.

Two parts only have appeared thus far and the above marks the limits of the events described in them. The work is written in an impartial spirit and promises to be an interesting and valuable addition to the history of this war. It is especially full of information of the movements of the troops on the side of the Boers, on which point most of the present accounts are somewhat weak and indefinite. An indication of the value set upon this history in Germany is the fact that the two numbers before us are already in their third edition.

There are a number of good maps, and they are quite adequate to illustrate the campaign, moreover, each number has an appendix containing the strength and organization of the various units.

J. P. W.

**Kriegsgeschichtliche Beispiele des Festungskrieges aus dem deutsch franzoesischen Kriege von 1870/71. Von Frobenius, Oberstleutnant a. D.**
**Erstes Heft : Belfort. Strassburg. Pp. 152.**
**Zweites Heft : Metz. Pp. 140.**
**Drittes Heft : Paris. Pp. 157.**
**Berlin : E. S. Mittler und Sohn, about $1.00 each number.**

The author of this new series of studies has been known for same time as a prominent military student, but especially by his valuable contributions to *Von Löbell's Jahresberichte.*

His present work discusses the tactical principles involved in the attack and defense of fortifications, as illustrated in the Franco-Prussian War, therefore it is not written solely for the artillery officer but also for officers of other arms.

The author proceeds in a truly critical spirit, recognizing the fact that the German victories in the sieges were not gained by that complete knowledge of the technical operations that should have characterized their General Staff, but simply by the hard work of the troops, in spite of comparatively poor dispositions.

The purpose of these studies, then, is to point out wherein the German leaders and General Staff officers failed, and to indicate what should be the mode of procedure in a future war in order to attain success.

The three opening numbers of this undertaking treat entirely of sieges of large cities, in which the enemy's works were *completely* surrounded [Einschliessung (Cernirung)] and reduced by regular siege operations.

The first case considered is that of Belfort, and the treatment of this section illustrates that of the others.

The conditions in the fortifications before the siege are first described, with suitable comments on the forces, armament and dispositions; then the

attackers' army is considered, with further comments; this is followed by a description of the execution of the operations which completed the environment of the fortification, and finally the steps or periods of the siege itself are outlined. The same method is followed in the other sieges, but, of course, in those on a grander scale, like Metz and Paris, there were several periods in the operations of completing the work of enclosing these immense intrenched camps.

The historical part is limited to that which is essential to a complete understanding of the *tactics* of the dispositions and operations, but is exceedingly clearly stated, and is evidently the result of the most careful study of the latest authorities. The critical part, or the comments, are the most valuable part, coming as they do from one who is a recognized authority on the subject, and given as they are in so broad a spirit.

No better study of the *tactics* of the attack and defense of land fortifications (intrenched camps), as illustrated by recent history, is known, and the completed work will stand as the world's authority on this subject. J. P. W.

**Kriegsgeschichtliche Beispiele aus dem deutsch-franzoesischen Kriege von 1870/71. Von Kunz, Major a. D. Elftes und Zwoelftes Heft. 1900. Berlin: E. S. Mittler & Sohn.**

We have had occasion to review the seperate numbers of this valuable series of historical examples as they appeared, and our remarks on the importance, scope and general excellence of the material apply with equal force to the present numbers.

Number eleven treats of examples of intrenchment on the field taken from the Franco-Prussian War as is consequently of especial interest to us, who practically introduced field intrenchments to the military world during our Civil War,—at least in the sense in which it is here used : field intrenchment to strengthen the natural terrain, on a large scale, and exerting a decisive influence on the battle. It is very interesting to note how much more extensive was the use of field intrenchments in this war than in that of 1866.

The battles selected to illustrate the use and effect of intrenchments are Spicheren, Gravelotte, Amiens, the intrenched camp at Orléans, and the battle on the Lisaine. Each is interesting in its own way, and the causes of success or failure in each case are clearly set forth.

The pamphlet concludes with a series of practical problems relating to the subject-matter, and comprises a list of works to be consulted for their solution.

The whole constitutes a study rich in lessons for the student of this aid to tactics which is gaining in importance with every new war.

The maps and plans are all-sufficient, with the exception of those relating to the intrenched camp at Orléans, in which the author, to keep the cost of the number low, refers to the maps in his separate work on that subject.

Number twelve recites the deeds of the infantry in battle and in the service of security and information, and is full of stirring incident and adventure, while every page is a lesson for the young officer.

The account opens with a number of examples of good judgment and energetic action on the part of non-commissioned officers and men, then takes up such on the part of first sergeants and candidates for commissions, followed by the brave deeds of lieutenants on the battlefield. In each case the tactical significance of the act is clearly set forth, as well as its effect on the general situation.

The author then relates the praiseworthy actions of separate companies or sections on various battlefields, and finally considers cases of effective flank fire, examples of ammunition supply under great difficulties, and the successful application of volley firing.

The entire number is more like a book of adventures than a work on the art of war, and yet each article has its appropriate lessons for the military student. J. P. W.

**Ost-Asien, 1860-1862, in Briefen des Grafen Fritz zu Eulenburg, Koeniglich Preussischen Gesandten betraut mit ausserordentlichen Mission nach China, Japan und Siam. 1900. Berlin: E. S. Mittler & Sohn. Pp. 428.**

This volume of letters by the German Ambassador sent on a special mission to China, Japan and Siam in 1860, has just been issued by the great German publishing house of Mittler & Sohn, and is edited by the present German Ambassador at the court of Vienna.

It treats of an epoch that marks the beginning of German interest and expansion in the East, and being at the same time the work of a man bred to political life, high in the councils of state in his own country, and one who executed his mission with such remarkable success, it should be of great interest to the world at large, especially just now, when all the civilized world is concerned with the far east.

The personal character of the letters (they were all written to members of his family at home) gives their great charm. They are perfectly free and outspoken, expressing the author's innermost thoughts and feelings, and incidentally gives us an insight into political and private life in the three countries named, at a time when they were yet practically closed to the outside world.

Altogether, the volume is a valuable addition to the history of the time, and at the same time a literary work of much merit, readable, interesting, and full of useful information. J. P. W.

**Drill Regulations for Mountain Artillery. Provisional. Prepared for the Use of Cadets of the U. S. Military Academy by 1st Lieutenant William Lassiter, 1st Artillery. Department of Tactics: Lieut.-Col. O. L. Hein, Commandant of Cadets.**

The great importance of mountain artillery was demonstrated in the war with Spain and in the Boer War, and is now apparent to the artillery officers serving in the Philippines. There is no official drill regulations for this gun as yet adopted, consequently this pamphlet, the result of careful study of the subject by the author, and considerable field experience in practice marches of light batteries and at Santiago, will be welcome to all who may be called upon to use this arm. J. P. W.

**Manual of the Service of Security and Information. Prepared for the Use of Cadets at the U. S. Military Academy, by 1st Lieutenant Edward Anderson, 7th Cavalry, Assistant Instructor of Tactics. Department of Tactics, West Point, N. Y. 1900.**

A conveniently arranged little volume on one of the most important subjects a soldier has to learn, a knowledge of which will be one of the very first

things required in time of war. The subject matter has been collected from the best modern authorities, and has been arranged in convenient form for study and reference. J. P. W.

**Military Lance Line Construction, for semi-permanent field telegraph and telephone lines, by Chas. De F. Chandler, First Lieutenant and Signal Officer First Battalion Engineers, O. N. G., Late Signal Corps, U. S. V. Kansas City, Mo., Hudson-Kimberly Publishing Co. Pp. 13, with plate of illustrations.**

This little pamphlet is in reality a manual for lance line construction, with many useful suggestions, and having been practically tested at Camps Alger, Meade and Mackenzie, as well as in Cuba, is entitled to recognition. The system suggested is simple and effective, and is evidently the work of a practical man, perfectly at home in his subject. J. P. W.

**A Catechism of Court Martial Duty. Arranged and Compiled by Major H. B. Spinelli, First Infantry, Texas Volunteer Guard, Counsellor-at-Law. Kansas City, Mo.: Hudson-Kimberly Publishing Co, 1900. Pp. 67.**

Major Spinelli's booklet is a model catechism. A counsellor-at-law by profession, the volunteer Major came to his subject well equipped, not only as regards his knowledge of law in general, but more especially of the law of evidence. However, the most commendable feature about the little volume is the system and arrangement and the appropriateness of the questions. The subject is divided into appropriate chapters, and each question is definite, sensible and to the point. The answers throughout the little work are authoritative and accurate. It is, of course, invaluable to the volunteer officer, but we can also recommend it to the regular officer as an aid to study and to refresh the memory. J. P. W.

**Die Feldgeschuetzfrage in ihrer gegenwaertigen Entwickelung. Von Nikolaus Ritter von Wuich, General-Major und Commandant der k. und k. technischen Militaer-Fachcurse.**

This pamphlet is a reprint of a lecture delivered by the author at the Military Casino in Vienna. As Major General, Commandant of the military technical courses, the author is in a position to present his subject as studied at the arsenals of Austria, as well as to give the government views resulting from such study.

It is an exhaustive philosophic essay on the subject, tracing its history and development in graphic outline. Three periods are considered in the development of the modern rapid-fire field gun:

1. The idea of *rapidity of fire* predominating.
2. The idea of effect of *individual shots* predominating, including the *curved trajectory pieces*.
3. The combination of the two preceding.

After discussing each in turn, the author notes what the principal nations have done in the matter of field guns, and then describes the elements of the latest system.

Such a work from the pen of so able an expert laborer in this field must command respect, and his essay will be studied with deep interest by all ordnance constructors and artillerymen. J. P. W.

**The Indikil System. A Decimal System of Weights and Measures for the English Speaking People. By A. Lincoln Hyde, Ph. B. Cleveland, Ohio. 1890.**

The author of this praiseworthy effort to give us a decimal system of weights and measures, after discussing the advantages of a decimal system in general, calls attention to the fact that although the majority of the people of the globe now use the metric system, the two great manufacturing nations of the world, Great Britain and the United States, have not yet seen fit to adopt it. This is due to the capital invested in machinery and in the manufacture of machinery, which is too enormous to permit of a change to a different system of units.

But, the author contends, this should not prohibit us from having a decimal system based on the inch, for example, and in the sequel he develops such a system, calling the inch and its successive multiples by ten, *in*, *id*, *ik*, *il*, respectively; the square inch and its successive deci-multiples, by *squin*, *squid*, *skuik*, *squil*; the cubic inch and its multiples by *cubin*, *cubid*, *cubik*, *cubil*; and finally the weight of a cubic inch of water and its multiples by *an*, *ad*, *ak*, *al*.

Such a system would have all the advantages of any decimal system, and has the great advantages over the metric system of simplicity of nomenclature, and avoiding the necessity of changing the units of measurement in our machine shops. J. P. W.

**Die Kuestenartillerie. Sigmund Mielichhofer, K. u. k. Hauptmann im Festungs-Artillerie-Regiment Nr. 4, 1900. Vienna: L. W. Seidel & Sohn. Pp. 70. 2.40 marks.**

The author of this excellent little essay on Coast Artillery, a captain in the Austrian heavy artillery, has devoted his attention to the study of coast fortifications, their proper location, their attack and defense, their armament and their fire command and control. Next to our own General H. L. Abbot, he is for our Coast Artillery officers perhaps the most interesting and useful authority now living. All his works bear on what may be called the *tactics of coast artillery*, and involve the questions of greatest moment for our artillery to-day.

His earlier works comprise:

*The Attack and Defense of Coast Fortifications.* 1897.

*The Defense of Coast Fortifications and of the neighboring open Coasts.* 1899.

*Aids to Coast Artillery Fire* (*Mitth. Art. u. G.* 12. 1899.)

The present work is the sequel of these, a sort of summary of them all, and yet a distinct number of the series.

In this he considers more particularly the gun question, *first*, as regards caliber, and *secondly*, as regards system, under the three conditions of action: against the heavy battleships, against lightly armored or unarmored warships, and against the smaller vessels.

In the first case, the main problem to be solved is, of course, to keep the enemy's heavy battleships at such a distance from a harbor as to prevent simultaneous bombardment of fortifications and roadstead, and also to prevent the enemy from approaching the harbor and forcing the passage into it. The defense for this purpose involves both guns and mine fields. Both are fully considered by the author, and the principles involved are clearly set forth.

In the second case the problems to be solved by the artillery of the defense are: the destruction of all the larger warships of the enemy which may take part in the removal of the outer obstructions; the combatting cruisers and other warships, not well protected by armor, that may take part in the artillery duel, and which cannot, on account of their weak armor, or their high speed, be effectively met by heavy guns; and finally, the proper supporting of the combat of the heavy guns against the enemy forcing an entrance, within the mine field.

In the third case the problem is to combat the smaller vessels like torpedo boats, submarine boats, etc., employed to reconnoiter or to break through the inner mines.

The second section of the work treats of the tactical principles involved in locating batteries and forts, and the third considers the conditions for effective fire, and the principal points to be attended to in training artillery for this purpose. The latter constitutes the most important chapter of the work.

The author concludes his essay with some very pertinent remarks on the proper organization of coast artillery troops, and agrees entirely with the views of our own artillery on this subject, namely, not only that the regimental organization is an absurdity, but that the strength of a garrison should not be determined by a fixed strength of any particular unit, but should be in proportion to the works to be manned.

J. P. W.

## BOOK NOTICES.

[These books will be fully *reviewed* as space becomes available.]

*A Practical Transmitter using the sine wave for cable telegraphy, and measurements with alternating currents upon an Atlantic Cable.* By A. C. Crehore, Ph. D., and G. O. Squier, Ph. D., Captain, Signal Corps, U. S. Army. Transactions American Institute of Electrical Engineers.

*Ballistic Tables.* Computed by Major James M. Ingalls, Fifth Artillery, under the Direction of the Secretary of War. Artillery Circular *M.* Washington: Government Printing Office, 1900.

# INDEX TO CURRENT ARTILLERY LITERATURE.

## PERIODICALS CITED.

Abbreviations employed in index are added here in brackets.

All the periodicals are preserved in the Artillery School Library, Fort Monroe, Virginia.

### ENGLAND.

**Aldershot Military Society.** *Occasional.*
*Aldershot. Copies* 6*d each.*

**Arms and Explosives.** [*Arms and Ex.*] *Monthly.*
*Effingham House, Arundel Street, Strand, London, W. C. Per year* 7*s.*

**Army and Navy Gazette.** [*A. and N. Gaz.*] *Weekly.*
3 *York Street, Covent Garden, London. Per year* £1 12*s* 6*d.*

**Canadian ilitary Gazette.** [*Can. Gaz.*] *Fortnightly.*
*Box* 2179 *Montreal, Canada. Per year* $2.00.

**The Engineer.** [*Eng.*] *Weekly.*
33 *Norfolk Street, Strand, London. Per year* £2 6*d.*

**Engineering.** [*Eng'ing.*] *Weekly.*
35-36 *Bedford Street, Strand, London, W. C. Per year* £2 6*d.*

**Journal of the Royal United Service Institution.** [*Jour. R. U.S.I.*] *Monthly.*,
22 *Charing Cross, Whitehall, London, S. W. Per year* 24 *s.*

**Journal of the United Service Institution of India.** [*Jour. U. S. I. India*] *Quarterly.*
*Simla, India. Per year* $2.50.

**Photographic Journal.** [*Photo. Jour.*] *Monthly.*
66 *Russell Square, London.*

**Proceedings of the Institution of Civil Engineers.** [*Proceedings I. C. E.*]
25 *Great George Street, Westminister, London.*

**Proceedings of the Institution of Mechanical Engineers.**
[*Proceedings I. M. E.*] 19 *Victoria Street, Westminister, London.*

**Proceedings of the Royal Artillery Institution.** [*Proceedings R. A. I.*] *Monthly.*
*Woolwich, England.*

**Professional Papers of the Corps of Royal Engineers.**
[*Prof. Papers Corps Royal Eng'rs.*]
*Chatham, England.*

**Review of Reviews.** [*Rev. of Rev. Austral.*] *Monthly.*
169 *Queen Street, Melbourne, Australia. Per year* 11 s. 6 d.

**Transactions of the Canadian Institute.** [*Trans. Canadian Inst.*]
58 *Richmond Street, Toronto, Canada.*

**Transactions of the Canadian Society of Civil Engineers.**
[*Trans. Canadian Soc. C. E.*]
*Montreal, Canada.*

**Transactions of the East of Scotland Tactical Society.**
[*Trans. E. of S. Tactical Soc.*]
51 *Hanover Street, Edinburgh, Scotland.*

**Transactions of the Institute of Naval Architects.**
[*Trans. Inst. Naval Architects.*]
5 *Adelphi Terrace, London, W.C.*

**United Service Gazette.** [*U. S. Gaz.*] *Weekly.*
10, *Wine Office Court, Fleet Street, London, E. C. Per year* £1 10 *s* 6 *d.*

**United Service Magazine.** [*United Serv. Mag.*] *Monthly.*
13 *Charing Cross, S. W. London. Per year* 27 *shillings.*

## FRANCE.

**Armée et Marine.** [*Armée et Mar.*] *Weekly.*
3 *Place du Théatre Français, Paris, France.*

**Le Génie Civil.** [*Génie C.*] *Weekly.*
6 *Rue de la Chaussée d'Antin, Paris. Per year* 45 *Fr.*

**Le Livre Militaire.** [*Livre Mil.*] *Monthly.*
6 *Rue de la Chaise, Paris. Per year* $1.00.

**La Marine Française.** [*Marine F.*] *Semi-monthly.*
26 *Rue de Grammont, Paris. Per year* 30 *Fr.*

**Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils.** [*Ingénieurs Civils.*] *Monthly.*
10 *Cité Rougemont, Paris. Per year* 36 *Fr.*

**Mémorial des Poudres et Salpêtres.** [*M. Poudres et S.*] *Quarterly.*
*Quai des Grands-Augustins*, 55. *Paris. Per year* 12 *Fr.*

**Le Monde Militaire.** [*Monde.*] *Fortnightly.*
6 *Rue de la Chaise, Paris. Per year* 8 *Fr.*

**Revue d'Artillerie.** [*R. Artillerie.*] *Monthly.*
5 *Rue des Beaux-Arts, Paris. Per year* 22 *Fr.*

**Revue de Cavalerie.** [*R. Cav.*] *Monthly.*
*Berger Levrault et Cie, Rue des Beaux-Arts* 5, *Paris. Per year* 33 *Fr.*

**Revue du Cercle Militaire.** [*Cercle.*] *Weekly.*
37 *Rue de Bellechasse, Paris. Per year* 27 *Fr.*

**Revue du Génie Militaire.** [*Génie M.*] *Monthly.*
8 *Rue Saint-Dominique, Paris. Per year* 27 *Fr.*

**Revue d'Infanterie.** [*R. Inf.*] *Monthly.*
11 *Place Saint André-des-Arts, Paris. Per year* 25 *Fr.*

**Revue Maritime.** [*R. Maritime.*] *Monthly.*
*L. Baudoin, Rue et Passage Dauphine* 30, *Paris. Per year* 56 *Fr.*

**Revue Militaire.** [*R. Mil. France.*] *Monthly.*
*R. Chapelot et Cie.*, 30 *rue et passage Dauphine, Paris. Per year* 20 *Fr.*

**Revue Militaire de l'Etranger.** [*Etranger.*] *Monthly.*
*L. Baudoin, Rue et Passage Dauphine* 30, *Paris. Per year* 15 *Fr.*

**Revue Militaire Universelle.** [*R. Univ.*] *Monthly.*

**Revue des Questions Militaires.** [*Quest. Mil.*] *Monthly.*
6 *Rue de la Chaise, Paris. Per year* $3.00.

11 *Place Saint André-des-Arts, Paris. Per year* 25 *Fr.*

**Le Yacht—Journal de la Marine.** [*Yacht.*] *Weekly.*
55 *Rue de Chateaudun, Paris. Per year* 30 *Fr.*

## GERMANY.

**Allgemeine Militaer-Zeitung.** [*A. M.-Zeitung.*] *Semi-weekly.*
*Darmstadt. Per year* 24 *M.*

**Beiheft zum Militaer-Wochenblatt.** [*Beiheft.*]
*Koch Strasse*, 68, *S. W.*, *Berlin.*

**Deutsche Heeres-Zeitung.** [*Heeres-Zeit.*] *Semi-weekly.*
*Wilhelmstrasse* 15, *Berlin.* *Per year* $6.00.

**Illustrirte Aeronautische Mittheilungen.** [*Aeronaut. Mitth.*] *Quarterly.*
*Kalbgasse* 3, *Strassburg i. E. Germany.* *Per year* $1.70.

**Internationale Revue.** [*Int. Revue.*] *Monthly.*
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**Allgemeine Schweizerische Militaer-Zeitung.** [*A.S.M. Zeitung.*] *Weekly.*
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**La Belgique Militaire.** [*Belgique M.*] *Weekly.*
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**Circulo Naval,—Revista de Marina.** [*Circulo Naval.*] *Monthly.*
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**Memorial de Artilleria.** [*M. de Art.*] *Monthly.*
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**El Porvenir Militar.** [*Porvenir.*] *Weekly.*
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**Revista Cientifico-Militar.** [*Cientifico M.*] *Semi-monthly.*
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*Largo de S. Domingos No.* 11, *Lisbon, Portugal. Per year U. S.* $6.00.

**Revista General de Marina,** [*R. G. de Marina.*] *Monthly.*
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*Rue do Conseheiro Saraiva n.* 12, *Rio de Janeiro, Brazil. Per year* $1.575.

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**Revista Militar.** [*R. Mil. Brasil.*] *Monthly.*
*Rio de Janeiro, Brasil. Per year*

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*Calle Colonia, No.* 379 *A. Montevideo, Uraguay.*

## HOLLAND AND SCANDINAVIA.

**Artilleri-Tidskrift.** [*Art. Tids.*] *Bi-monthly.*
*Artillerigården Stockholm, Sweden. Per year, U. S.*, $1.75.

**De Militaert Gids.** [*M. Gids.*] *Bi-monthly.*
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**Norsk Militaert Tidsskrift.** [*N. M. Tids.*] *Monthly.*
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## RUSSIA.

**Artilleriiskii Journal.** [*Rus. Art. Jour.*] *Monthly.*
*Furschtatskaia Ulitza, St. Petersburg, Russia.*

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*KoloKolwaia Ulitza, No.* 14, *St. Petersburg, Russia.*

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*Wadizdinskia Ulitza, No.* 48, *St. Petersburg, Russia.*

**ITALY.**

**Rivista di Artiglieria é Genio.** [*R. Artig.*] *Monthly.*
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**La Corrispondenza.** [*Corrispondenza*]. *Monthly.*
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**American Machinist.** [*Amer. Mach.*] *Weekly.*
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**American Manufacturer and Iron World.** [*Man. and Iron World.*] *Weekly.*
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**Annual of the Office of Naval Intelligence.** [*Naval Intelligence.*]
*Washington, D. C.*

**Army and Navy Journal.** [*A. and N. J.*] *Weekly.*
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**Army and Navy Register.** [*A. and N. R.*] *Weekly.*
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*University Heights, New York City. Ten numbers per year.* $5.00 *per year.*

**Cassier's Magazine.** [*Cas. Mag.*] *Monthly.*
3, *West* 29*th Street, New York City. Per year* $3.00.

**Electrical World and Electrical Engineer.** [*Elec. Eng.*] *Weekly.*
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**Electrical Engineering.** [*Elec. Eng'ing.*] *Monthly.*
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**The Engineer.** [*Eng. Cleve.*] *Fortnightly.*
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**Engineering Magazine.** [*Eng'ing. Mag.*] *Monthly.*
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**Journal of Electricity.** [*Jour. Elec.*] *Monthly.*
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**Journal of the American Chemical Society.** [*J. Chem. S.*] *Monthly.*
*Easton, Pa. Per year* $5.00.

**Journal American Society of Naval Engineers.** [*A.S.N. Egrs.*] *Quarterly.*
*Navy Department, Washington, D. C.*

**Journal of the Association of Engineering Societies.** [*Eng. Soc.*] *Monthly*
257 *South Fourth Street, Philadelphia. Per year* $3.00.

**Journal of the Franklin Institute.** [*Frank. Inst.*] *Monthly.*
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**Journal of the Military Service Institution.** [*Jour. M. S. I*,] *Bi-monthly.*
*Governor's Island, New York City. Per year* $4.00.

**Journal of the U.S. Cavalry Association.** [*Jour. U. S. Cavalry*] *Quarterly.*
*Fort Leavenworth, Kansas.*

**Journal of the Western Society of Engineers.** [*W. Soc. Eng.*] *Bi-monthly.*
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**Marine Review.** [*Mar. Rev.*] *Weekly.*
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**Military Information Division.** [*Mil. Information Div.*] *Occasional.*
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**Notes on Naval Progress.** [*Naval Intelligence.*] *Occasional.*
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**Pennsylvania Magazine of History and Biography.** [*Penn. Mag. of Hist.*
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**The Photographic Times.** [*Phot. Times.*] *Weekly.*
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**Physical Review.** [*Phys. Rev.*] *Ten numbers per year.*
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**Popular Science Monthly.** [*Pop. Sc. Mo.*] *Monthly.*
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**Proceedings of the American Philosophical Society.**
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104 *South Fifth Street, Philadelphia, Pa.*

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[*Proc. A. S. Civil Engr's.*] *Monthly.*
220 *West* 57*th Street, New York City.*

**Proceedings of the U. S. Naval Institute.** [*Naval Inst.*] *Quarterly.*
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**Technology Quarterly.** [*Tech. Quart.*] *Quarterly.*
*Mass. Inst. of Tech., Boston, Mass.* *Per year*, $3.00.

**Telephone Magezine,** Illustrated, [*Telephone Mag.*] *Monthly.*
*Marquette Building, Chicago, Ills.* *Per year* $1.00.

**Transactions American Institute of Electrical Engineers.**
[*Inst. Elec. Eng'rs.*] *Monthly.*
26 *Cortlandt Sti eet, New York City.* *Per year* $5.00.

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99 *John Str., New York City.*

**Transactions of the American Society of Civil Engineers.**
[*Trans. A. S. Civil Eng'rs*]
220 *West* 57*th Street, New York City.*

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12 *West* 31*st Street, New York City.*

**Transactions of the Society of Naval Architects and Marine Engineers.**
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**Western Electrician.** [*West. Elec.*] *Weekly.*
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**Wilson's Photographic Magazine.** [*Phot. Mag.*] *Monthly.*
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Improvements in the army and navy of the United States.—**Heeres-Zeit.**, March 31.

The cavalry of Holland.—**Heeres-Zeit.**, March 31.

The Turkish army in 1899.—**R. Mil.**, France, June.

The changes in the German army in 1900.—**R. Mil.**, France, June.

The English nation and its army.—**Cercle**, July 14.

The railroad sapper battalions.—**Razv.**, 504.

The French expeditionary corps in China.—**Cercle**, July 23.

The reserve batteries.—**Razv**, 505.

Portuguese colonial troops.—**Cercle**, June 23.

Organization measures of Napoleon after the campaign of 1812.—**Vereine**, 1.

The reorganization of our field artillery.—**Vereine**, 4.

The Chinese soldier.—**Home Magazine**, August.

The Italian naval budget, 1900-1901.—**Seewesens**, VIII.

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Contrast in British and Boer systems.—**A. and N. Jour.**, July 21.

Utilization of the conscripted sailors in the defense of coasts.—**Marine F.**, June.
The Imperial Japanese navy.—**Eng.**, April 6.
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The changes in the armies of the world.—**Int. Rev.**, July.
Reorganization for central staff.—**Jour. M. S. I.**, July.
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Mounted infantry.—**Jour. M. S. I.**, July.
The Russian General Staff.—**Jahrbuecher**, July.
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Reorganization of the Bavarian army.—**R. Mil.**, France, July.
Organization of the Portuguese army.—**R. Mil.**, Brazil, March, April.
Separation of the duties of the Engineers.—**R. Mil.**, Brazil, March, April.
The German cavalry in the next war.—**R. Mil.**, Brazil, March, April.
Troops of the lines of communications in Germany.—**R. Artig.**, June.
The artillery of the Boers.—**R. Artig.**, June.
The organization of technical arms and corps.—**Mitth. Art. u. G.**, 7.
The Intendantur system of the German army.—**Jour. R. U. S. I.**, July.
The English volunteer electrical engineers in South Africa.—**Kriegstech. Z.**, 7.
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Notes on the evolution of cavalry.—**Unit. Serv. Mag.**, July, August.
The French army of to-day.—**Unit. Serv. Mag.**, July.
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The staff of the British army.—**Unit. Serv. Mag.**, July.
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The attack and defense of field intrenchments in the Boer War.—**Heeres-Zeit.**, March 31.
The History of the French infantry.—**R Inf.**, June, July.
Historical essay on cavalry tactics.—**R. Inf.**, June, July.
Infantry formations and maneuvers in the field.—**R. Inf.**, June, July.
Troops in campaign.—**R. Inf.**, June, July.
Tactical problem.—**Cercle**, July 7.
Study of a tactical question.—**R. Univ.**, July, August.
Drill in battle tactics.—**Vereine**, 5.
The attack and defense of fortified field positions.—**Int. Rev.**, July, **Beih.**, 12.
The defense of ports.—**R. Mil.**, Brazil, May.
Marches and battles.—**Porvenir**, May 1.
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The tactics of cavalry.—**R. Cav.**, June, July.
The lessons of the 16th of August.—**R. Cav.**, June, July.
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An introduction to the study of naval tactics.—**Naval Inst., June.**

The 5-inch howitzers: fire tactics.—**Proc. R. A. I.**, January-February.

How a field gun of greater power might be used equal to the 5-inch howitzer in mobility.—**Proc. R. A. I.**, January-February.

Methods of ranging a group of guns in a Coast Battery and maintaining accurate fire without the aid of a position finder or depression range finder.—**Proc. R. A. I.**, January-February.

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The deployment of the infantry by the artillery positions.—**Jahrbuecher**, July.

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Dispersed order under the new regulations.—**Invalide**, 83.

Artillery fire in night operations.—**R. Artig.**, June.

The new ideas on the war of the future.—**R. Artig.**, June.

Considerations on the Coast Defence problem.—**R. Artig.**, June.

Problem in examination to staff college.—**Monde**, June 30.

Tactical problem.—**Monde**, July 15.

The combat of the battalion —**Monde**, July 25.

The defense of coasts. **R. G. de Marina**, July.

Lessons of the war.—**Jour. R. U. S. I.**, June.

An Italian view of the Boer War.—**Jour. R. U. S. I.**, July.

Firing on coast defences. —**Jour. R. U. S. I.**, June.

The methods of attack of fortifications.—**Kriegstech. Z.**, 6.

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The fire tactics of the French artillery.—**Wochenblatt**, July 7, 11.

The passage of streams by cavalry.—**Armée et Marine**, July 22.

Artillery questions.—**Wochenblatt**, July 25, 28.

Shall the cavalry be applied in mass or in small subdivisions?—**Wochenblatt**, July 28.

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Examples of the strategic use of cavalry by Napoleon.—**Beiheft**, 5.

The Russian cavalry in the war of 1877-8.—**R. Cav.**, June.

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The campaign of 1809.—**R. Cav.**, June, July.

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An Italian view of the Boer war.—**Jour. R. U. S. I.**, June, July.

Lessons of the South African war.—**Wochenblatt**, June 30, July 4.

Strategic importance of fortifications in the light of the war in South Africa and in Virginia (1864-5).—**Wochenblatt**, July 11.

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General Dugommier.—**R. Univ.**, July, August.

The general situation in Madagascar.—**R. Univ.**, July, August.

The Spanish-American War.—**R. Mil.**, France, June.

The campaigns of Marshal Saxe.—**R. Mil.**, France, June.

The war of 1870-71.—**R. Mil.**, France, June.

The Army of the North under Luckner.—**R. Mil., France, June.**

Report on Battle of San Mateo.—**A. and N. Jour.**, July 28.
Notes on the Spanish-American war.—**R. Belge**, May-June.
The Spanish-American war (D. Bonamico).—**R. Maritt.**, June, July.
The war with Paraguay (1866).—**Porvenir**, May 1-24.
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The defense of Portugal.—**Exercito**, June.
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France's Soudan campaign.—**Heeres-Zeit.**, June 30-July 14.

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The German infantry firing regulations.—**R. Inf.**, June, July.
Troops in campaign.—**R. Inf.**, June, July.
Formations and Maneuvers of the infantry in the field.—**R. Inf.**, June, July.
Maneuvers of the Prussian railroad troops in 1899.—**Genie M.**, June.
Imperial German maneuvers in 1899.—**Cercle**, July 7, 14.
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A proposed new method of scoring target practice in the navy.—**Naval Inst.**, June.
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## BALLISTICS, RANGE FINDING AND POINTING.

Rupture by high explosives.—**Genie M.**, June.

Accuracy of U. S. magazine rifle.—**Shooting and Fishing**, August 2.

Analytical study of the trajectory of projectiles in vacuo.—**Cientifico M.**, June 1, 15.

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The Queen-Schultz chronoscope.—**Scien. Amer.**, August 4.

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The works of the port of Lorenzo Marques.—**Engenheria M.**, May.

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Methods and results of surveys for Oswego-Mohawk Ship Canal Route.—**Eng'ing News**, June 28.

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The latest developments in metro-photography.—**Photo. Jour.**, June.

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Improvements in tool steel.—Elec. World, August 11.

Talbot open-hearth continuous steel process.—Eng'ing. News, July 12.

The Taylor-White tool-steel process of the Bethlehem Steel Co.—Eng'ing. News, August 9.

The analysis of chrome and tungsten steels.—Eng'ing and Min. Jour., August 4.

Open hearth continuous steel process.—Eng'ing., June 22.

## ELECTRICITY AND HYDRAULICS.

Electrical measuring instruments.—Elec. Rev., July 4, 11.

New types of automatic circuit breakers.—Elec. Rev., July 4.

Ericsson portable testing set.—West. Elec., June 30.

A practical transmitter using sine wave for cable telegraphy (illustrated), Prof. Crehore and Capt. Squier.—Trans. Inst. Elec. Engrs., May.

English searchlights.—West. Elec., July 14.

G. I. high-tension circuit-breaker.—West. Elec., July 14.

The projected cable line to the Philippines.—Elec. Rev., July 11, 18.

Lightning arresters for direct current circuits.—Elec. Rev., July 18.

Thermodynamics of the voltaic cell.—Phys. Rev., July.

A new form of electrical condenser.—Phys. Rev., July.

On the theory of the Coherer.—Phys. Rev., July.

A method of studying electrostatic lines of force.—Phys. Rev., July.

Electrical resistance of thin films deposited by Kathode discharge.—Phys. Rev., July.

Electrical measuring instruments.—Frank. Inst., July.

Electromagnetic mechanism.—Frank. Inst., July, August.

Wireless telegraphy notes.—Seewesens, VIII.

A storage battery spark ignition.—Amer. Mach., August 9.

Storage batteries for small stations.—Eng. Cleve., August 1; West. Elec. July 7.

New form of telephone transmitter.—Elec. World, July 7; Elec. Rev., August 1.

G. I. automatic circuit breakers.—Elec. World, July 7; West. Elec., July 7.

Electroiytic interrupters.—Elec. World, August 11.

Indicating and recording instruments.—Elec. World, August 11; Elec. Rev., August 8.

The Fisher cable testing set.—Elec. World, August 11.

Some modern types of direct-current generators.—Elec. Rev., July 25.

The progress of wireless telegraphy.—R. Belge, May-June.

Possibilities of wireless telegraphy.—Inst. Elec. Engrs., March.

Hysterisis of iron and steel.—Inst. Elec. Engrs., March.

Single-phase motors.—Inst. Elec. Engrs., March.

New method of tracing alternating curves.—Inst. Elec. Engrs., March.

Practical transmitter using the sine wave for cable telegraphy (Crehore and Squier).—Inst. Elec. Engrs., May.

New Keelyn telephone apparatus.—West. Elec., July 7.

Steljes typewriting telegraph.—West. Elec., July 21.

Improved induction coils.—West. Elec., July 21.

Field telegraphy at Mafeking.—West. Elec., July 28.

Gilmore selector system of typewriting telegraphy.—West. Elec., August 4.

Curves of candle powers of arc lamps (illustrated).—**West. Elec.**, August 4.

Another cable to Europe opened (New York to Azores).—**West. Elec.**, August 11.

The Marconi installation on the *Wilhelm der Grosse*.—**Naval Inst.**, July.

Murray high-speed page-printing telegraph.—**Scien. Amer.**, August 11.

The Dardeau direct-call telephone.—**Eng'ing.**, July 27.

The future of power development.—**Eng. Mag.**, August.

Belting.—**Eng. Cleve.**, July 16.

Leather Belts and their use.—**Eng. Cleve.**, July 2.

High pressure packing.—**Eng. Cleve.**, July 2.

The Coggeshall boiler tube cleaner.—**Eng. Cleve.**, July 16.

Gas engines and the economy of gasoline engines for small power.—**West. Elec.**, July 21.

## MILITARY GEOGRAPHY.

The projected cable line to the Philippines.—**Elec. Rev.**, July 11.

The Kiangnan Arsenal.—**Eng.**, July 6.

The climatic and sanitary conditions of Southern China.—**Invalide**, 134.

Lord Beresford in China.—**Cas. Mag.**, August.

The real situation in China.—**Home Magazine**, July.

Naval docks of the United States.—**Man. and Iron World**, June 28.

A new transatlantic cable.—**Elec. Rev.**, August 1.

Another cable to Europe opened (New York to Azores).—**West. Elec.**, August 11.

The new Alaskan cable.—**Elec. Rev.**, August 8.

Topography of the Nicaragua Canal route.—**Eng'ing News**, July 12.

Deep waterways from the Great Lakes to the Atlantic.—**Eng'ing News**, July 12.

Map of northeastern China.—**A. and N. Jour.**, August 11.

Scene of the war in China (map).—**A. and N. Reg.**, July 21.

China in regeneration.—**Eng. Mag.**, August.

The material development of Porto Rico.—**Eng. Mag.**, August.

The ship-building yards of the U. S.—**Eng. Mag.**, August.

Military utility of geological knowledge.—**Prof. Papers Royal Engineers**, vol. XXV.

Puerto Rico.—**Jour. M. S. I.**, July.

Notes on Cuban ports.—**Naval Inst.**, June.

The strategic geography of Europe.—**Proc. R. A. I.**, January-February.

The Rhine-Elbe canal.—**Eng'ing.**, June 22.

War maps.—**Jour. R. U. S. I.**, July.

Marines and coaling stations.—**Unit. Serv. Mag.**, July.

## TRANSPORTATION, QUARTERS AND SUBSISTENCE.

Typical American railway bridges (illustrated).—**Eng'ing News**, July 5.

Locomobiles (road locomotives) for the production of electric light in the Transvaal.—**Genie M.**, June.

Transportation of heavy loads in war.—**Vereine**, 5.

Military automobiles.—**Quest. Mil.**, June ; **R. Belge**, May-June.

Armored train for South Africa.—**Eng.**, May 18.

The Schweitzer system of bread-making in Paris.—**Scien. Amer.**, July 28.

Ideal ration for army in Tropics (Woodruff).—**Jour. M. S. I.**, July.

Military requisitions.—**R. Mil.**, Brazil, March, May.

The ration of the military horse.—R. Mil., Brazil, May.
Temporary barracks in France.—Genie M.. July.

## BICYCLES, AEROSTATION AND PHOTOGRAPHY.

A military automobile.—Scien. Amer., June 30.
Our bicycles.—Razv., 505.
Military automobiles.—R. Belge, May-June; Quest. Mil., June.
The *free wheel* bicycle.—Eng., July 20.
Field gun automobile carriage.—Kriegstech, Z., 7.
A new pedal for bicycles.—Kriegstech. Z., 7.
Trials of motor wagons at the German maneuvers.—A. S. M. Zeit., June 30.
The bicycle in war.—A. S. M. Zeit., July 28.
Count v. Zeppelin's airship.—Kriegstech. Z., 6; A. S. M. Zeit., July 28.
The ascension of Count v. Zeppelin's airship.—Scien. Amer., August 11.
Aerostation at the disposition of the commander-in-chief.—Int. Rev., July supplement 16.
The new airship of M. de Santos Dumont (illustrated)—Scien. Amer., July 7.
Taking care of lenses.—Photo. Mag., July.
Telephotography.—Photo Mag., July.
The latest developments in metro-photography.—Photo. Jour., June.
Toning with ferrocyanides.—Photo. Bulletin, July.
A new printing paper.—Photo. Bulletin, July.
A modification of the Metol Developer.—Photo. Bulletin, July.
Brilliant blue prints.—Photo. Bulletin, July.
Ammonium persulphate in intensification.—Photo. Bulletin., July.
Standard developers.—Photo. Times, August.

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Examination for admission to the Staff College, France.—Cercle, July 21.
Staff College.—R. Club Mil., June, July.
Admission to Staff College, 1901.—Monde, June 30.
St. Cyr in 1900 (beautifully illustrated).—Armée et Marine, July 29.

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Infectious diseases.—R. Belge, May-June.
The biolysis of sewage.—Prof. Papers Royal Engrs., Vol. XXV.
Ideal ration for army in tropics (Woodruff).—Jour. M. S. I., July.
Study of bullet wounds.—Jour. M. S. I., July.
A test of the mosquito theory of malaria.—Jour. M. S. I., July.
Dentists for the army.—Jour. M. S. I., July.
Malarial and non-malarial mosquitoes (illustrated).—Scien. Amer., July 7.
A portable water sterilizer.—Eng., April 6.

## SMALL-ARMS AND EQUIPMENTS.

Gleanings from the U. S. Ordnance Report.—Shooting and Fishing, July 19, 26, August 2, 9.
Clothing of the troops.—Cercle, July 23.
The Browning automatic pistol.—Belgique M., July 29.
The automatic Colt pistol.—Iron Age., August 2.
Small arms in the Philippines.—A. and N. Jour., August 4.
The Mauser automatic repeating rifle.—Proc. R. A. I., March.

Arms and ammunition used in South Africa.—**Int. Rev.**, July, supplement 16.

Accuracy of U. S. magazine rifle.—**Shooting and Fishing, August** 2.

A new bit.—**R. Cav.**, June.

Treatise on portable fire arms.—**Cientifico M.**, June 1, 15.

Effect of small-arm projectiles.—**R. Mil.**, Portugal, July 15.

Repeating arms actually in use.—**Quest. Mil.**, June.

Cracking of metallic cartridge cases.—**R. Mil.**, Brazil, March, April.

Revolvers and repeating pistols.—**Mitth. Art. u. G.**, 7.

The effect of small-arm projectiles.—**Kriegstech. Z.**, 6.

Bullet-proof shields for troops.—**Kriegstech. Z.**, 6.

An improved wire stretcher.—**Kriegstech. Z.**, 7.

A device for preventing too-high aim in small-arms.—**Kriegstech. Z.**, 7.

Cavalry small-arms.—**Kriegstech. Z.**, 7.

A device for upsetting small-arm projectiles in flight.—**Kriegstech. Z.**, 7.

The French artillery officer's sabre.—**Kriegstech. Z.**, 7.

Infantry equipments of aluminum (Russia).—**Kriegstech. Z.**, 7.

Photo-stereo binocular field glasses.—**Kriegstech. Z.**, 7.

## WARSHIPS AND TORPEDO BOATS.

The Japanese battleship *Asahi*.—**Eng'ing.**, June 22, 29; **Naval Inst.**, July.

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Analysis of the *Bellisle*.—**Mar, Rev.**, June 28.

Russian cruiser *Variag*.—**Mar. Rev.**, June 28.

Two notable high-speed foreign cruisers (*Askold* and *Chateaurenault*).—**Scien. Amer.**, June 30.

New type of battleship in Italy.—**Armée et Marine**, June 24.

*Majestic* against *Belleisle*.—**Armée et Marine**, June 24.

*Lavoisier* against Torpedo Boat 104.—**Armée et Marine**, June 24.

The firing on the *Belleisle*.—**Schiffbau**, July 8

A successful submarine boat (the *Raddatz*).—**Elec. Rev.**, July 18.

The first-class transport *Nive* (illustrated).—**Yacht**, July 14.

The German battleship *Fürst Bismarck*.—**Yacht**, July 14.

A study on the Ram.—**Mar. Rundschau**, July.

Submarine warfare.—**Cercle**, June 23.

The sloop-of-war *Wampanoag*.—**Cas. Mag.**, August.

The Imperial Japanese navy.—**Cas. Mag.**, August.

The remarkable trial trip of the *Kentucky*.—**Home Mag.**, August.

The building of a battleship.—**Home Mag.**, August.

The Austrian torpedo ram *Kaiser Karl VI*.—**Seewesens**, VII.

The Russian cruiser *Askold*.—**Seewesens**, VII.

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The double turrets of the *Kearsarge*.—**Schiffbau**, June.

Torpedo boat *Lampo*.—**Schiffbau**, June.

Changes in the world's navies.—**Schiffbau**, June, July.

Submarine navigation for war purposes.—**R. Maritt.**, June.

Notes on foreign navies.—**R. Maritt.**, June, July.

The new Japanese destroyers.—**Boletin, Argentina**, May.

The French cruiser *Cecille*.—**Boletin, Argentina**, May.

The future of the auxiliary fleet.—**Marine F.**, July.

The law relating to the German navy.—**Mar. Rundschau**, July.

Submarine boats.—**Naval Inst.**, July.

The U. S. cruisers of the *Denver* class.—**Naval Inst.**, July.

The Royal navy.—**Mar. Rundschau**, July.

Changes in the world's navies.—**Int. Rev.**, July; **R. Maritime**, May, June.

Naval construction in Germany.—**Int. Rev.**, July, Supplment 16.

The artillery power of the *Bouvet* compared with that of the *Majestic*.—**R. Maritime**, June.

The English navy.—**R. Maritime**, June.

The *Sea gull*, torpedo gunboat.—**R. Maritime**, June.

The *Denver*, protected cruiser.—**R. Maritime**, June.

New cruisers of the U. S.—**R. Maritime**, June.

The *Rio-de-la-Plata*, Spanish cruiser.—**R. Maritime**, June.

The *Proserpina*, Spanish destroyer.—**R. Maritime**, June.

A study of modern battleships.—**R. Maritime**, May.

Naval war game in Russia.—**R. Maritime**, May.

English destroyers.—**R. Maritime**, May.

*Pandora*, *Pegasus*, *Pyramus* and *Viper*.—**R. Maritime**, May.

*Wien*, *Monarch* and *Budapest*.—**R. Maritime**, May.

*Argonaut* (American submarine boat).—**R. Maritime**, May; **R. de Marina**, May.

*General Baquedano*.—**R. Maritime**, May.

Warships building in England.—**Mar. Rev.**, July 19.

The Japanese Navy.—**Naval Inst.**, July; **Mar. Rev.**, July 26, August 9.

Torpedo boats for the Dutch navy.—**Mar. Rev.**, August 2.

*Variag's* remarkable performance.—**Mar. Rev.**, August 2.

The battleship of the future.—**Mar. Rev.**, August 9.

The project of naval defense (France).—**Yacht**, June 23.

The Russian armored cruiser *Bayan*.—**Yacht**, June 23.

The German battleships.—**Yacht**, June 30.

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The monitor *Huascar*.—**R. de Marina**, May.

The *Goubet No.* 2.—**R. de Marina**, May.

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Japanese destroyers.—**Naval Inst.**, July.

Japanese first-class torpedo boats.—**Naval Inst.**, July.

The Navy estimates.—**Naval Inst.**, July.

The destroyer *Bat*.—**Naval Inst.**, July.

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The development of the German navy.—**R. Mil., France**, July.

Attack on the *Belleisle*.—**Scien. Amer.**, July 21.

High speed in war vessels: *Variag* and *Viper*.—**Scien. Amer.**, August 11.

The Imperial Japanese navy.—**Eng.**, April 6.

H. M. S. *Aboukir*.—**Eng.**, May 18.

Torpedo boats for the Dutch navy (illustrated).—**Eng'ing.**, July 20.

The German battleship *Kaiser Wilhelm II*.—**Jour. R. U. S. I.**, July.

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A normal chlorine map of Long Island.—**Tech. Quart.**, June.

Apparatus for determination of ammonia in water by Wanklyn method, and total nitrogen by Kjeldahl method.—**Jour. Chem.**, August.

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A method for rapid gravimetric estimation of line.—**Jour. Chem.**, August.

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Logarithmic slide rules.—**Proc. R. A. I.**, January-February.

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JOURNAL
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# INSTRUCTION OF COAST ARTILLERY.

The instruction of the enlisted men of the artillery assigned to the care, preservation and service of the new coast forts and of the new artillery material mounted therein and connected therewith is a matter meriting serious and present consideration. The subject of coast artillery instruction at posts lacks and has always lacked a proper directing head; it lacks uniformity, progressive continuity, co-ordination and completeness. It will be the aim of this paper to suggest, in mere outline, a scheme of instruction for enlisted men, designed to cover more completely than at present the technical field above referred to. The scheme will essay to take up the recruit and carry him by progressive steps through to a point of instruction where he may be in position to discharge his duties with a fair knowledge of the science of artillery and some degree of practice in its several branches.

In a former paper* it was pointed out that the complete service of a modern fort with its proper equipment of guns of large and small caliber, range and position finders, electric plant for power and light, and sub-marine mines, naturally divides itself into four subdivisions, namely:

1. The service of the guns.
2. The service of the range and position finders.
3. The service of the electric plant, for light and power.
4. The service of the sub-marine mines.

These may be taken as fundamental divisions of work, service and command, each requiring its own instructed personnel. When the fort is in action all must work together harmoniously as parts of the same unit under the directing agency of the Fire Commander.

* "The Fighting Unit in Coast Defense." *Journal of the Military Service Institution*, No. 90, November, 1897.

It is believed that the authorized scheme of instruction of the enlisted men of the coast artillery should recognize these "services," which are so naturally differentiated, and that it should be laid out and adjusted to be in harmony with them. Assuming such a relation as a premise, the enlisted personnel of coast artillery may be divided into four classes, as follows:

1. *Cannoneers.*—Including all enlisted men who have not passed a qualifying examination for the grade of "Gunner."

2. *Gunners.*—Including all enlisted men who have passed a standard examination in the following subjects:

a. School of the Soldier, Infantry and Artillery.
b. Guard duties of enlisted men.
c. First aid to the wounded.
d. Artillery definitions and nomenclature of artillery material.
e. Manual of the several service guns, mortars and machine-guns.
f. Care and service of ammunition.
g. Service of the hydraulic jack, the gins and other mechanical appliances used in moving and mounting heavy ordnance and ordnance material.
h. Service of small boat.
i. Aiming and laying of guns and mortars.
j. Simple use of range tables and range scales.

3. *Electricians.*—Including all "gunners" who have passed a standard examination in the following subjects:

a. Theory of magnetism and electricity.
b. Care, preservation and use of electric dynamos, batteries, motors, lines, lights, and all machines and appliances used in coast defence.
c. Signalling with flag, torch, heliograph and telegraph.

4. *Machinists.*—Including all "gunners" who have passed a standard examination in the following subjects:

a. Elementary mechanics.
b. Strength of materials.
c. Applied mechanics; mechanisms.
d. Steam and other engines.
e. Application of mechanical principles in gun carriages, hoists and other machines used by coast artillery.
f. Care, preservation, use and repairing of gun carriages and other machines used by coast artillery.

5. *Torpedoists.*—Including all "gunners" who have passed a standard examination in the following subjects:

a. Elementary chemistry.
b. Theory of explosion.
c. Handling and tests of service explosives.
d. Preparation and loading of submarine mines.
e. Placing ground and buoyant mines.
f. Laying and connecting cables for system of mines.
g. Care, preservation and use of system of mines completely installed.

6. *Artillery Experts.*—Including all enlisted men, who, having qualified in all of the above grades, pass, in addition, a standard examination in the following subjects:

a. Algebra to include the solution of simple equations; logarithms.
b. Use of mathematical instruments and plotting board.
c. Use of angle measuring instruments.
d. Solution of triangles.
e. Range and position finding instruments, principles and use.
f. Use of meteorological instruments.
g. Use of ballistic machines and pressure guages.
h. Ballistics and advanced use of range tables.

The instruction of these "classes" should be assigned to the "service divisions" referred to above as follows:

To the Gun Service Division: 1. The Cannoneer Class, 2. The Gunner Class.

To the Electrical Service Division: 1. The Electrician Class, 2. The Machinist Class.

To the Sub-marine Mine Division: The Torpedoist Class.

To the Range and Position Finding Division: The Artillery Expert Class.

Those who had qualified as Artillery Experts would be available as teachers in any of the other divisions to which they might be assigned by the commanding officer.

The instruction in each division should be under the supervision of the commissioned officer at the head of the division—the Chief of the division.

Until the first class of Artillery Experts had qualified the instruction would have to be given directly by commissioned officers and such special men as even now we find in small numbers in each battery among our "Gunner Specialists" and "First Class Gunners."

An officer should be placed on duty in the War Department,

and assigned to all matters pertaining to the instruction of coast artillery troops. He should have one or two subordinate officers to assist him and such clerical assistance as might be necessary to examine all reports submitted of progress and of examinations; to keep the personal records of all grades above that of "gunner", and to prepare consolidated reports of the same for publication in orders.

It is thought that a schedule of instruction could be arranged for each coast-artillery post that would carry a class through a prescribed course, covering the ground indicated above, within one instruction year.

According to the plan here suggested the instruction of each of the "classes" named would be conducted separately during some part of each working day. The working day might, for example, be divided into instruction periods, and an annual programme of instruction drawn up assigning specifically study or work to each period. The aim would be to proceed progressively through each course along the lines laid down above and at the end of the year's instruction to have an examination of all candidates to establish their qualifications for the grade of the course.

Such a programme might, for example, assume the instruction year to begin October first and terminate May thirty-first, the final examination being held the last of May. Following this idea the subjects of instruction might be distributed to each class as follows:—

THE CANNONEER CLASS.

(Looking to qualification for the grade of "gunner.")

*October.*

The School of the Soldier.

a. Exercises without arms (pp. 3–25, Inf. D. R.)
b. Exercises with arms (pp. 25–44, and pp. 55–62, Inf. D. R.)
c. Exercises in squad drill (pp. 44–54, and 186–204, Inf. D.R.)
d. Care of arms, equipment and clothing; arrangement of lockers and packing knapsacks.

*November.*

The Manual of Guard Duty (pp. 1–60, Manual of Guard Duty).

a. Guard mounting (practice drill).
b. Posting, relief and duties of sentinels (practice drill).
c. Compliments from guards and sentinels (practice drill).

Tent pitching (G. O. No. 13, H. Q. Dept. Texas, 1897).

First Aid to the Wounded (pp. 99–103, Hospital Corps D. R.).

Care and Preservation of Artillery Material.

*December.*

Artillery Definitions and Nomenclature (pp. 7–13, 36–49, 27–33, D. R. Coast Arty.; and Arty. Circular I, Ch. VI.).

Litter Drill (pp. 27–56, D. R. Hospital Corps).

Care and Preservation of Artillery Material.

*January.*

Manual of Rapid-fire guns; nomenclature and ammunition of the same.

Care and Preservation of Artillery Material.

*February.*

Manual of Large Caliber Guns (pp. 81–94, D. R. C. A.).

Nomenclature of Large Caliber Guns (Arty. Circ. I., Ch. VI. and IX.).

Ammunition of Large Caliber Guns (Arty. Circ. I., Ch. VII. and VIII.).

Small Boat Drill.

Care and Preservation of Artillery Material.

*March.*

Same as for February.

*April.*

Manual of Mortars; nomenclature and ammunition of same (pp. 95–, D. R. C. A.).

Care and Preservation of Artillery Material.

*May.*

Manual of Machine Guns (Arty. Circ. K.).

Care and Preservation of Artillery Material.

Examination for Grading as "Gunners."

THE ELECTRICIAN CLASS.

*October.*

Magnetism (Ch. II. Thompsons' Electricity and Magnetism, or equivalent).

Signaling (flag and wand).

*November.*

Current Electricity (Ch. III. Thompsons' Electricity and Magnetism, or equivalent).

Mounting, Dismounting and Care of Electric Batteries.

Signaling (flag and torch).

*December.*

Electromagnetics (Ch. I. Thompsons' Electricity and Magnetism, or equivalent).

Making Electro-magnets, and simple applications thereof.

Signaling (heliograph).

*January.*

Electrical Measurements (Ch. VI. Thompsons' Electricity and Magnetism, or equivalent).

Signaling (heliograph, continued).

*February.*

Principles Connected with Conversion of Electricity into Heat, Light and Power (Ch. VII. Thompsons' Electricity and Magnetism, or equivalent).

Signaling (telegraphy).

*March.*

Induction Currents (Ch. X. Thompsons' Electricity and Magnetism, or equivalent).

Care, Preservation and Repairing of Electric Motors, Dynamos and other Electric Machines Used in Coast Artillery.

Signaling (telegraphy, continued), and Use of Electric Machines.

*April.*

Installation and Use of Telegraph and Telephone Lines.

*May.*

Review of Course.

Examination for Grading as "Electrician."

THE MACHINIST CLASS.

*October.*

Elementary Mechanics.

Varieties and Strength of Woods and the Use of Carpenters' Tools.

*November.*

Applied mechanics.

Wrought Iron, its Properties and the Use of Forge Tools.

*December.*

Applied mechanics, continued.

Cast Iron, Brass and Bronze, their Properties.

Elementary Foundry Work.

*January.*

Applied mechanics, continued.

Steel and its Properties.

Elementary Machine Shop Work.

*February.*

Machine Shop Work, continued.

*March.*

Experimental Work on Duplicate Parts of Guns and Carriages, Preparing, Finishing and Repairing the same.

*April.*

Experimental Work, Reproducing Standard Gearing of Gun Carriages and other Artillery Machines.

General Repair Work.

*May.*

General Work in all of the above Branches.

Examination for Grading as "Machinist."

THE TORPEDOIST CLASS.

*October.*

Elementary Chemistry.

*November.*

Theory of Explosion.

Care and Handling of High Explosives.

*December.*

Service tests of Explosives.

Smokeless Powders (Artillery Circular "B," Ch. VI., or equivalent).

*January.*

Care, Preservation and Storage of Mine Materials.

*February.*

Preparing, Handling, Loading and Planting of Sub-marine Mines (Ground).

*March.*

Praparing, Handling, Loading and Placing of Sub-marine Mines (Buoyant).

*April.*

Laying, Connecting and Testing Mine Cables and other Parts of the Mine-field Circuit.

*May.*

Care, Preservation and Use of the Completed Mine Syetem.

Explosion Practice with Improvised Mines.

Examination for Grading as "Torpedoist."

THE ARTILLERY EXPERT CLASS.

*October.*

Mathematics (Artillery Circular "H," Chapters I. to X., or equivalent).

*November.*

Mathematical and Angle Measuring Instruments (Arty. Circ. "H," Ch. XI. and XII).

Plotting Board.

*December.*

Mathematics to Include the Solution of Simple Algebraic

Equations, Logarithms, and the Solution of Triangles by Trigonometry and Geometry (Arty. Circular "H," XIII. to XVII).

*January.*

Use of Meteorological Instruments (Artillery Circular "D").

*February.*

Ballistics (Chapter I. Artillery Circular "F").

*March.*

Ballistics (Chapter II. Artillery Circular "F").

*April.*

Range and Position Finding Instruments (Arty. Circ. "E").

*May.*

Use of Ballistic Machines and Pressure Gauges; taking velocities and pressures.

Examination for Grading as "Artillery Expert."

Attention is again invited to the statement that the details here given are submitted merely in a suggestive way, they are intended simply to illustrate the principle of distinct work in each "Division," and the progressive nature of this instruction, limited to one instruction year.

At the conclusion of the examinations the Chief of each Division should make a detailed report thereon, with his recommendations in regard thereto, to the Officer in Charge of Instruction at Army Headquarters. This report should be made through the post commander, who should endorse his comments thereon.

After the examination reports had been examined and compared, the names of those who had passed the examinations successfully should be announced in orders, specifying the "grades" in which each candidate had qualified.

Insignia of some kind should be allowed to be worn by each grade so that the classification of a command could be apparent at a glance.

These "grades" should be recognized by law and a small addition of pay should be allowed for each grade gained. Such additional pay would encourage men to put forward their best efforts and would attract a higher type of recruits to the coast artillery than we now get; it would also repay the United States for the outlay in the increased efficiency of the whole body of coast defenders.

Beginning June first the entire command of each coast fort should be exercised in *combined* work, covering, say, the following ground:

*June.*

Ship Tracking, Simulated Firing, Fire Direction, Fire Control, Night Alarm, Repulse of Mock Land Attack, Mechanical Maneuvres.

*July.*

Sub-caliber Practice at Fixed and Moving Targets, with Fire Direction and Control, Repulse of Small-Boat Attack on the Mine Field, Mechanical Maneuvres, Night Sub-caliber Practice, Submarine Improvised-mine Explosions by Drifting or Sailing Mine-targets.

*August.*

Full-caliber Practice at Fixed and Moving Targets, Explosions of Service Mines by Drifting or Sailing Mine-targets, Mechanical Maneuvres.

*September.*

Infantry Drill, (Close and Extended Order), Field Instruction (Tent Pitching, Making and Breaking Camp, Practice Marches), Small-arm Target Practice.

To summarize: The foregoing scheme of instruction follows along the natural lines of coast artillery work. It first trains the recruit in his individual duties (a) as a soldier, (b) as an artilleryman; it provides a personnel capable of serving efficiently in *each* branch of artillery work connected with the defense of a modernly equipped fort; it finally trains these separately instructed "classes" *in combination*, as parts of the same fighting unit, so that the defense of a fort may be scientific and harmonious, not hap-hazard and discordant. Recognizing the necessity of some measure of proficiency in infantry drill, for riot and other duty, temporarily, away from the coast forts, the month of September is devoted to that drill.

E. M. WEAVER,
Captain 1st Artillery.

# THE SECOND BOER WAR.*

Continued.

IV.

The third act in the drama has closed, the decisive battle of the war has been fought, but there are still many elements of strife to be subdued, and finally the contending elements must be harmonized to restore peace and quiet permanently.

The third act closed with the defeat of Cronje, the advance of the British into the Orange Free State from the west, the relief of Kimberley, the retreat of the Boers from Cape Colony and in Natal, and the relief of Ladysmith.

The weakening of the Boer forces in Natal was very poor policy for it failed to help Cronje on the one hand, and left the road to Ladysmith open on the other, moreover, it indicates a weakness in the leadership of the troops, for the proper course was undoubtedly to fall upon General Buller with all available forces, and to strike a blow there to counteract the disastrous events in the west. This separation of the forces was a serious mistake in strategy, but may have been called forth by the fact that the coalition between the Transvaal and Orange Free State was none too strong, and the discipline of the Boers comparatively weak, so that the Orange Boers preferred to protect their own land rather than help the Transvaal Boers to finish the campaign for both.

The forces at the opening of the fourth act (about the beginning of March) were distributed as follows:

*In the Western Theatre.*

Lord Roberts, after Cronje's capitulation, took up a position fronting to the east, on both sides of the Modder River, his headquarters at Osfontein (about 5 miles east of Paardeberg), the 6th division (Kelly Kenny) on the right, holding all kopjes to a distance 5 miles south of the Modder, the 7th division (Tucker) at the center, close to the river, the 9th division (Colville) on the north bank, the cavalry (French) on the extreme left, and the mounted infantry (Colonel Ridley-Martyr) on the right. The troops were given a rest of several days, with a view

* In addition to the authorities and sources of information already acknowledged, the editor desires to express his obligations to the following:

*Der Krieg im Transvaal*, 1899-1900, Tiedemann, Oberstleutnant z. D.; *Der Krieg in Südafrika*, Kunowski und Fetzdorff; *Jahrbücher der deutsche Armee und Marine; Proceedings Royal Artillery Institution.*

to supplying them with full rations once more, reestablishing the communications and preparing for the advance on Bloemfontein.

The reconnoisance of the cavalry had developed the fact that the Boers were intrenching themselves on a series of Kopjes about 8 miles east of Robert's position, their position extending several miles north and south of the Modder. These troops were under the command of Delarey and De Wett, and numbered about 14,000. Other Boer columns were reported coming from the north-west of Kimberley and from the south-east towards Petrusberg.

Lord Methuen, from Kimberley, had occupied Boshof on the road to Bloemfontein, and had sent a column to relieve Mafeking.

*In the Southern Theatre.*

In Cape Colony the Boers (8,000) retreated towards the Orange River, followed by the columns of Generals Brabant, Gatacre and Clements. The forces confronting Roberts were partly these troops from the south. West of the De-Aar–Hopetown line and in Griqualand West a serious uprising of the inhabitants took place, but Lord Kitchener, who was in charge of the lines of communication, with headquarters at De Aar, readily suppressed it.

*In the Eastern Theatre.*

In Natal General Buller rested and reorganized his troops in Ladysmith camp, assembling a large force near Helpmakaar with a view to resuming the offensive at an early date: as soon as White's division would be ready for service again. The Boers under Joubert (20,000) occupied a position on the Biggarsberg, north of Ladysmith, their left near Dundee, with detachments in the passes of the Drakensberg as far south as Bezouitenhout Pass. This was still the main Boer army.

This was the general situation at the opening of the fourth act. The country between Osfontein and Bloemfontein is not especially favorable for the Boer tactics, but their purpose probably was to delay Roberts as much as possible along this route, thus giving time for the main army to reorganize and establish itself on more favorable ground north of Bloemfontein where the country is more hilly and broken, the crests often rising to a height of 8,000 feet above the sea.

For the British the campaign thus far had been a very severe one, especially on the horses of the cavalry, and some time was needed for their recuperation; moreover, the supplies had been

short, owing to the loss of a considerable part of their train as well as the natural consequences of such strenuous efforts as the army recently made in the way of marching and fighting, and time was required to bring the supply of food and forage to the normal state again. The country was very poor in water and the army was therefore tied to the vicinity of the river.

The natural consequence of the British invasion of the Orange Free State was that many of the burghers left the army to defend their own houses, and thus the Boer army was greatly reduced in a comparatively short time, and the resistance to Roberts' advance was gradually weakened.

### GENERAL ROBERTS' CAMPAIGN.

#### Battle of Poplar Grove.

On March 7th General Roberts continued his advance. French's division, composed of 3 brigades of cavalry, 2 of mounted infantry, and 7 batteries started at 1 A. M. in a south-easterly direction, followed by Kelly-Kenny's division, and at daybreak struck the left of the Boer lines, posted on a group of seven hills, near Poplar Grove. French attempted to turn the left flank of the Boers by means of Porter's brigade and several guns. The British guns soon silenced those of the Boers, and Porter continued his advance but came upon a second Boer position, farther to the rear, from which he received heavy musketry fire. He sent cavalry and mounted infantry against this position, but he had the enemy on two sides of him and so found himself in a difficult situation. However, the howitzers and guns of Kelly-Kenny's division came into play soon after this and forced the enemy in the advanced position to retire from the hills in a northerly direction, thus freeing Porter.

The artillery of Kelly-Kenny advanced and attacked the second or actual Boer position, while the cavalry worked on the flanks. The Boers were gradually driven back, and finally, when the cavalry threatened their line of retreat, they fled in confusion towards the north and east pursued by the cavalry.

The British lost 1 officer killed and 4 wounded; 3 men killed, 46 wounded and 1 missing.

The British horse artillery did excellent service, and the fighting was practically confined to the cavalry, which was very nearly exhausted. The British captured one gun, and great quantities of forage, stores, tentage, etc.

Roberts moved his headquarters to Poplar Grove.

The infantry on the north of the Modder River crossed to the south at Poplar Drift (opposite Poplar Grove), and General

Roberts' further advance was continued along the south bank. The 7th division (Tucker) on the right, moving on the Petrusberg road towards Aasvogel Kop, the left of the Boer position covering Bloemfontein. The 6th division (Kelly-Kenny) in the

A Camp in Roberts' Army.—*Armée et Marine.*

center, over the open country. The cavalry division (French) on the left, close to the river, followed by the rest of the troops.

**The Battle of Driefontein.**

On the morning of March 10th Broadwood's brigade of French's division came in contact with the Boers at Driefontein, 8 miles

south of Abraham's Kraal, and drove their outposts back, attempting then to outflank the position. The Boers kept up a heavy artillery fire. About 1 P. M. Kelly-Kenny's division arrived before the center and left of the Boers, and then Broadwood took his brigade to his left, made a wide detour and came upon the rear of the enemy before night fall. Meanwhile, Kelly-Kenny's division attacked at the center and worked around the enemy's right flank. By 2 P. M. the horse batteries cleared the way for the infantry, which advanced to the attack. Finally they stormed the Kopjes at the charge, and took the heights at the point of the bayonet, but not until after a hard fight lasting six hours.

The Boers were commanded by Delarey, and were mainly those from Colesberg. They had had no time to intrench, although the heights afforded good natural positions, and scattered rocks gave some shelter.

The British lost 7 officers killed and 16 wounded; 66 men killed and 313 wounded. The Boers left 173 dead on the field and 20 prisoners

The strength of the British forces was about 45,000, that of the Boers about 12,000.

Lord Roberts reported to the Presidents of the two Republics that their troops had abused the privilege of the white flag, and of the signal of holding up the hands in token of surrender; and also that he had captured large quantities of explosive bullets, which are being used by the Boers. Lord Roberts reported to the War Office that the wounds, as a rule, are more serious than usual, owing to expanding bullets having been freely used by the Boers.

#### The Occupation of Bloemfontein.

After the battle of Driefontein Lord Roberts, instead of following the retreating Boers, turned to the south-east, along the Kaal Spruit, in the direction of Bloemfontein, the capital of the Orange Free State. On the 11th he reached Aasvogel Kop, and on the 12th Venters Vallei, 18 miles south-west of the capital, and about 10 miles west of the railroad. The cavalry division was ordered to push on and sieze the railroad station and its rolling material. French struck the railroad six miles below Bloemfontein in the morning and by evening succeeding in taking two hills close to the station, which commanded the town. On the morning of the 13th the 3d Cavalry Brigade and mounted infantry from the 7th division were sent to support French, and the town was called upon to surrender, on pain of being bom-

barded; the white flag was raised at noon, and a few hours afterwards Lord Roberts entered and took possession.

The President, Mr. Steyn, and the officials fled to Kroonstadt, which was proclaimed as the new capital.

The British captured 8 locomotives and much rolling stock.

Lord Roberts set to work at once to reestablish the government of the district south of the Modder River. General Pretyman was designated as military governor. The civil affairs were turned over to Mr. Fraser, a member of the former government, but a friend of the English. Many of the former officials who remained were retained, and the burghers were allowed to retire peaceably to their homes on condition that they would not take up arms again in the present struggle.

The result of this tolerance was that the Boer line on the Orange River broke down at once. Of course, the fact that Lord Roberts had penetrated to the rear of this line had its natural effect, but its immediate collapse was due to the fact that many of the burghers preferred to accept Lord Roberts' conditions.

The moral effect of the occupation of Bloemfontein was of course very great, not only on the Boers of the Orange Free State as well as the Transvaal, but also on the native uprisings in western and northern Cape Colony; but the strategic effect was far greater, as it gave the British control of the important—nay indispensable—railroad line from Colesberg to Bloemfontein, a line not only necessary to supply the army in its present position, but absolutely required for any further advance northward. Besides, Bloemfontein, with its natural advantages and its generous water supply, formed an excellent base of supply for the subsequent movements of the army.

Lord Roberts had another problem to solve, before he could advance, viz.: to transfer his base at Modder River station and his overland line of communications to the railroad. The Boers had destroyed the bridge at Norvals Pont, but as the British had previously prepared the necessary parts for repairing it and held them all ready to ship to that point, this work would not require over two weeks. Meanwhile 2,000 Kaffirs had been ordered there to effect the transportation of supplies and material over the Orange River.

The security of the lines of communications was left to Lord Kitchener, a master in that art. Lord Roberts also recognized the danger of the uprising in the south-west, and on March 19th sent Lord Kitchener to the Prieska and Carnarvon districts to suppress it. General Settle was sent to Prieska (85 miles west

of Hopetown, on the Orange River) with a force of mounted infantry, and Sir Parsons to Van Wyks Vlei (215 miles west of Colesberg).

Another care of General Roberts was to insure his junction with Generals Brabant, Gatacre and Clements, coming up from Cape Colony, to facilitate which he sent General Pole-Carew with a brigade by rail to Springfontein, the junction of the railroads from Norvals Pont and from Bethulie, where the advancing British troops could be supported against any Boer resistance on the Orange River by threatening the rear of the enemy.

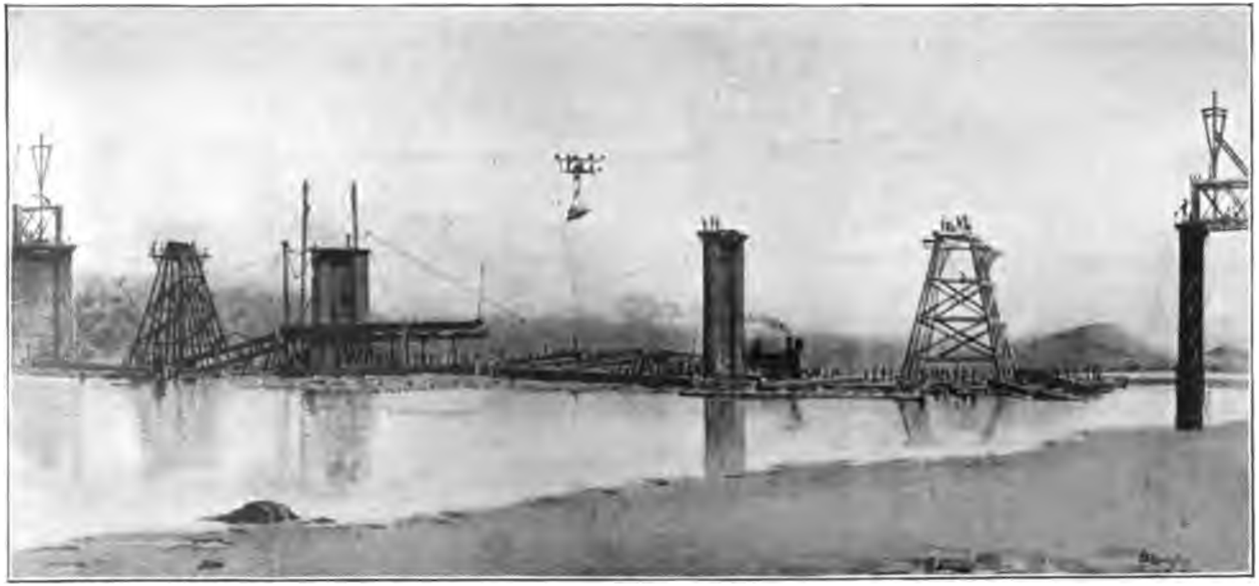
The troops were greatly in need of rest and reorganization, especially the arm in which the British army excelled, and which had increased in importance as the army advanced, viz.: the cavalry; moreover, the supply trains, on account of the great loss of pack animals *en route* from Modder River Station, were not in condition for any farther advance, and so, for all these reasons, it became imperative to give the troops a long rest, in spite of the fact that such a delay would also afford the Boers time to gather their forces at some advantageous point and prepare a strong defensive position. The raid to Kimberley broke down nearly twenty per cent. of the British horses, and over 1,700 horses were disabled. On the way from Kimberley to Bloemfontein, over the hot plain, a large number were foundered or died, so that in all the cavalry was short about 10,oco horses, and remounts had to be awaited.

### EVENTS IN THE SOUTHERN THEATRE.

At the beginning of March Generals Brabant, Gatacre and Clements, meeting with no resistance in their front, began to advance from Jamestown, Molteno and Colesberg behind the retiring Poers. They moved slowly in order to take on the way the measures necessary for quieting the inhabitants of the districts through which they passed.

General Brabant moved from Dordrecht on 3d, the with about 1,800 men, on the 4th took possession of the Boer position at Labuschagnes Nek, about 6 miles north of Dordrecht. On the 5th he attacked the Boers north of this position, and, after an all-day fight, defeated them. The British lost about 30 killed and wounded, and captured wagons, rifles and cattle in large quantities.

General Gatacre reoccupied Stormberg on the 5th of March, and thus came in railway communication with General Clements at Colesberg; on the 7th he occupied Burghersdorp, while Brabant reached Jamestown, and Clements advanced to Norvals



Restoration of Norvals Pont Bridge.

A Boer Patrol at Thaba 'Nchu. —*Armée et Marine.*

Pont, on the south bank of the Orange River. At the last-mentioned place the enemy, after retiring over the river on the 6th, blew up the bridge.

On March 12th Brabant was at Aliwal North, Gatacre at Bethulie bridge and Clements at Norvals Pont. When Gatacre reached the Orange River the railway bridge had been destroyed, and the enemy were preparing to demolish the road bride, but were driven off before they could accomplish their purpose. On the 15th he occupied Bethulie. Patrols of Clements' force effected a juncture with Gatacre's troops near Burghersdorp, and a patrol from Bethulie bridge effected a union with Brabant's column.

On March 4th, on which day Brabant defeated the rear guard ot the Boer column from Dordrecht at Aliwal North, the three columns were practically in touch with one another. It appears that the Boers in their retreat had become demoralized, failed to take proper measures to insure the service of security and information, and were consequently completely surprised by the rapid advance of the British. As a result, they were unable to make a firm and concerted stand on the Orange River. On the 16th the three British columns crossed the river without opposition.

The Boer column retiring over Aliwal North, commanded by Grobler, assembled at Smithfield; that over Bethulie, under Olivier, joined them at Smithfield, thus combining to a force of about 5,000 men and 16 guns. The combined columns, under Olivier, then moved over Wepener on Winburg, to join the Boer forces there. The column over Norwals Pont (600) under Van der Post, assembled at Fauresmith.

On the 18th Clements was advancing on Phillipolis and Fauresmith; Gatacre was established at Springfontein, with a detachment at Springfield and the Scots Guards holding the railway at Edensburg; and Brabant occupied Rouxville, preparing to move along the Basutoland border.

#### EVENTS IN THE WESTERN THEATRE.

Lord Kitchener remained in the Prieska and Carnarvon districts, south-west of Orange River Station, pacifying the uprisings kindled by roaming bodies of Boers, until March 27th, when he returned to De Aar. About 200 rebels made their submission, and others retired over the Orange River.

Cronje left Modder River station on March 4 for Cape Town.

He was to be held a prisoner at St. Helena till the close of the war.

The Transvaal Boers, augmented in number since the relief of Kimberley, reoccupied Griquatown. Bobies of rebels were reported at various points, commandeering and looting. A body of 800 Boers with 4 guns held the north bank of the Vaal at Fourteen Streams, and attacked the British at Warrenton, but without success. Lord Methuen, who had gone to Barkly-West to restore order, returned to Kimberley on the 27th.

General Snyman was still investing Mafeking in the month of March. Colonel Plumer's force was checked at Lobatsi by an offensive advance of the Boers on March 16th; whereupon he made a raid to within 12 miles of Zeerust against the line of communications of Snyman's force, and returned to Ramathlabama, only six miles from Mafeking. The Boers, however, drove him back with heavy loss to Gaberones.

### EVENTS IN NATAL.

The relieving force under Sir Redvers Buller marched through Ladysmith on March 3d. On the 9th the Naval Brigade of the

ARMORED TRACTION TRAIN.—*Engineering.*

*Powerful* returned from Ladysmith to Durban. The line between Colenso and Ladysmith was clear, but the Boers began entrenching on the Biggarsberg, as proven by a reconnaissance to Pomeroy on the road to Helpmakaar, by Bethune's Horse.

The British army occupied a line extending from Acton Homes and Dewdrop in the west, to Elandslaagte and Sunday's River in the east, with outposts along a line from Van Reenan's Pass to Helpmakaar. The Boers occupied the Biggarsberg with about

14,000 men and 20 guns, and had strong detachments in De Beers, Tintwa and Van Reenan's Passes. The cavalry of Dundonald reconnoitred continually on the left flank, while Bethune's Horse guarded the right, and felt its way forward.

Pomeroy, on the Zululand border road, was burned by the Boers on March 23d.

### LORD ROBERTS' CAMPAIGN.

#### Pacification of Conquered Territory.

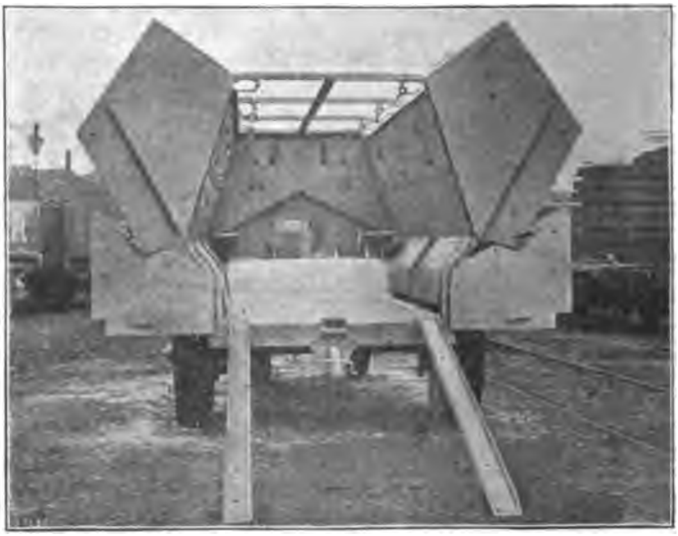
As soon as the army had rested and sufficiently recuperated, and the system of supply was in normal working order again, Lord Roberts directed his attention more particularly to pacifying the conquered territory—the southern part of the Orange Free State—, and to secure his lines of communication.

ARMORED TRACTION TRAIN. -*Engineering*.

His first move was to intercept, if possible the retreating Boer columns from Cape Colony, the principal of which was that under Olivier (5,000 men with 16 guns), retreating over Smithfield and Wepener towards Winburg. For this purpose Lord Roberts sent General French with his division to cut Olivier off on the Thaba 'Nchu–Ladybrand road. A brigade of cavalry had been sent to Thaba 'Nchu as early as March 18th, to quiet the inhabitants, but on the 26th General French's division advanced towards Ladybrand, which his advance guard occupied. He was too late, however, as Olivier had already passed that point on his way north, gathering to his standard many of the Boers who had returned to their homes.

The rejection of the peace propositions of Presidents Krüger and Steyn by the British government was followed by flaming proclamations by both these rulers calling upon the Boers to continue the struggle to the end. In consequence of this many returned to the army.

French's movement was observed by a Boer outpost near Brandfort, and a commando under Crowther was promptly sent to Ladybrand to hold the road open for Olivier. Crowther drove French's advance guard back and compelled him to give up his mission, as he had no infantry with which to dispute the the ground. French left Broadwood's brigade at Thaba 'Nchu, and returned with the rest to Bloemfontein.



ARMORED TRACTION TRAIN.—*Engineering.*

The Boer force at Fauresmith, under Van der Post, slipped through to the north at Petrusberg and Poplar Grove, reaching the Boer lines at Bultfontein.

The British columns from Cape Colony, after uniting with Pole-Carew's brigade, moved northward on a broad front, taking all necessary measures to pacify the inhabitants and to restore peace and order. One of the great objects of Lord Roberts—the junction of his main army with the scattered columns in Cape Colony—had thus been accomplished.

Clements entered Fauresmith and Jägersfontein on the 27th, and, leaving a garrison at the latter place, reached Bloemfontein on the 8th of April; Gatacre made his headquarters at Spring-

fontein, and Brabant remained at Aliwal North. Gatacre and Brabant were required to preserve order in this portion of the captured district, and to secure the lines of communication.

### Preparations for Advance.

Depressing as were the consequences of Cronje's surrender for the Boers, there were many indications at this time that their spirit was not yet broken, and that Lord Roberts had still a numerous and active enemy to contend with.

The first element was the Afrikander uprising, which was still going on in the rear of Roberts' army, and along his long lines of communication. In the next place the success of Olivier in eluding the British, combined with President Steyn's determination to stand by the treaty of alliance with the Transvaal, and President Krüger's to carry on the war to the end, had given the Boers new courage and inspired them with a new enthusiasm. Their numbers, due to the return of many on the call of the Presidents, had risen considerably, and but few of the reinforcements Lord Roberts received had been available at the front. As regards war supplies, arms and ammunition, the Boers were well prepared and had enough for a long war. In losing Joubert and Cronje, on the other hand, they suffered most, for they had no leaders to fully replace them, although Botha and De Wett, for the kind of warfare they decided to wage, were remarkably well fitted. Finally, their tendency to assume the *tactical offensive* in small bodies seemed always to have been greater than on a large scale, consequently their new mode of warfare benefitted thereby.

Before resuming his advance, therefore, it was not only necessary to reorganize the troops, remount the cavalry, and secure the lines of communication, but also to quell disturbances in and to pacify the conquered districts, to clear the country of the numerous smaller bodies of Boers, or at least to locate them and determine their strength, with a view to leaving behind detachments to watch them, and to counteract the effects of Krüger's and Steyn's proclamations by such measures of leniency or severity as may be found most effective.

Evidence of this new energy of the Boers were felt in all directions. Some of these have already been referred to, namely, the repulse of Methuen at Fourteen Streams, and of Plumer at Lobatsi, the attack on French's advance guard and its expulsion from Ladybrand, and, in Natal, the burning of Pomeroy. Other evidences made themselves felt and gradually on a larger and larger scale.

On March 20th the two railroad bridges north of Bloemfontein (over the Modder and the Vet Rivers, respectively) were destroyed by the Boers.

Roberts' army near Bloemfontein was posted as follows: 7th division, 1st and 3d cavalry brigades, at Glen, near the Modder River; 6th division in Bloemfontein; 2nd cavalry brigade at Thaba 'Nchu; 9th division in Bloemfontein; 1st and 2d brigades mounted infantry near Karree Siding, with portions at Thaba 'Nchu and other points.

On March 25th the British reconnoitring towards Brandfort had a small skirmish with the Boers.

*Action at Karee Siding.*

On the 31st General Roberts found it necessary, in consequence of the activity of the Boers, under General Smets, in his immediate front, to drive them from some kopjes they occupied near Karee Siding Station, a few miles south of Brandfort. The operation was conducted by the 7th division, assisted by the 1st and 3d cavalry brigades under French, and Le Gallais's regiment of mounted infantry.

The group of isolated hills at Karee Siding trends east and west, extending over about 5 miles of ground. The line was occupied by about 3000 Boers.

Tuckers's division was sent to Glen. French, with his cavalry division, was sent to the west to turn the Boer position, while Le Gallais, with the mounted infantry and 3 guns (37 mm.) was to do the same by the east. Tucker was to attack in front after the turning movements were completed.

At 10 a. m. French sent a heliograph message that he was in position in rear of the hills, and Tucker advanced to the attack.

The infantry pushed the Boers back gradually, but they resisted with some energy till about 4 p. m., when French's artillery opened on them from the rear. The Boers then retired precipitately. The mounted infantry did not reach their rear in time to cut them of.

The British took the kopjes after a six hour fight and held them. They lost 2 officers killed, 7 wounded; and about 100 men killed, wounded and missing.

The success of the British was due to the enveloping attack (around both flanks) made by the cavalry, but the fact that no pursuit was attempted indicates that the latter was not yet in proper condition for active operations.

*Action near Bloemfontein Water Works, on the Koorn Spruit.*

On March 30th Broadwood, who had been left at Thaba 'Nchu, 38 miles east of Bloemfontein, having received information that two strong forces from the north and east were approaching his position, retired to the waterworks, which were 17 miles nearer Bloemfontein, and where he had a detachment of two companies of mounted infantry for the protection of the works, near Sanna's Post. General Roberts sent the 9th division to his support.

Broadwood's force consisted of the Household Cavalry, the 10th hussars, Q and U Batteries horse artillery, and Pilcher's battalion mounted infantry, in all about 1,400 men.

De Wet, hearing on the 30th that Broadwood had retired from Thaba 'Nchu, decided to intercept him, and by a forced night march, with a force of about 8,000 men, reached the British camp before daybreak, and made his dispositions for attack.

At dawn Broadwood found himself attacked on three sides. He immediately despatched his two horse-artillery batteries and his baggage towards Bloemfontein, covering them with his mounted troops. At the point where the road crosses the Koorn Spruit, about 2 miles from the waterworks, a Boer force was so well concealed that the scouts had not discovered them, but as the artillery and the train entered the drift the Boers opened fire at short range, shooting down drivers and horses. Such as were able galloped away covered by Roberts' Horse. Meanwhile, another passage was found where the remainder of Broadwood's force crossed and reformed. The horse-artillery guns that got out, formed at Klip Kral, a group of ten houses over the Koorn Spruit, and opened on the Boers, but they were soon driven back by cross fire. The 9th division, after a magnificent march, arrived on the scene of action at about 2 P. M. French with 2 brigades had also been ordered up, but did not arrive in time to take part in the action.

The Boers retired towards Ladybrand, leaving 20 wounded officers and seventy wounded men. Broadwood lost 7 guns and all his baggage, about 150 killed and wounded, and 200 missing.

*Action at Pietfontein, near Boshof.*

The column of Boers under Van der Post, which slipped through the British lines from Fauresmith north, remained in that vicinity and sent out detachments from Koodoos Rand, in the direction of Poplar Grove, to disturb the British communications between Modder River Station and Bloemfontein. One of his outposts, to protect his rear in the direction of Kimberley, 70 men strong, was surrounded by Methuen's troops from Boshof

on April 5th and captured, the French Colonel of Engineers, Villebois, being among those who fell in the attack. The British lost 1 officer and 1 man killed; 10 men wounded. The Boers lost 8 killed, 8 wounded, and 54 prisoners.

*Action at Reddersburg.*

The Boer columns under De Wet and Olivier again took up their offensive movement southward, early in April. On the 3d De Wet reached Reddersburg, where he fell upon a small British force and captured it.

This force, composed of 3 companies 2nd Royal Irish Rifles and 2 companies 9th Regiment Mounted Infantry, had been sent to De Wet's Dorp, 40 miles east of the railway, to receive arms of the burghers, and on the way back to Bethany it found its way intercepted a few miles east of Reddersburg by a large force with guns. The British detachment rushed to a kopje near by, and held it for 18 hours, when, all hope of reinforcement being abandoned, they surrendered. The battle opened in the afternoon of the 3d, and the English, without artillery, defended themselves till 2 A. M. on the 4th, at which time all their ammuntion was expended. At daybreak, therefore, they were compelled to surrender.

Gatacre, at Springfield, in spite of the thunder of the Boer artillery all the afternoon, was not informed of the battle until late in the evening, when he received an order from Lord Roberts to send reinforcements. The latter he took by rail to Bethany, and then marched across country, but did not reach the field till noon of the 4th,—too late to be of any use. He therefore retired to Bethanie.

In consequence of this mishap General Gatacre was relieved from command on the 9th and ordered home. General Pole-Carew was placed in command of his troops.

The British lost 2 officers killed, 4 wounded, and 9 captured; 10 men killed, 33 wounded and about 400 captured.

THE GENERAL SITUATION.

Before discussing the movements of Olivier's column, which began at the same time as those of De Wet's against Reddersburg, and which resulted in the siege of Wepener, a glance at the general situation will enable us to obtain a clearer understanding of Lord Robert's preliminary movements and his resumption of the advance.

The Boers were distributed somewhat as follows: around Ladybrand 10,000 on the; Vaal, from Fourteen Streams to Christiania 6000; at Brandfort about 6,000; near Boetsap (Barkly West)

400; near Witrand (Barkly West) 700; about Kroonstadt 5,000; and in the eastern theatre (Natal) about 14,000.

The general plan of the Boers was evidently to attack Roberts at the center near Brandfort, and at the same time to make a raid around his right flank over Wepener against his communications in rear, and another against his left flank over Paardeberg, and to threaten the extreme left at Kimberley by an advance from Barkly West and Fourteen Streams.

The British had nearly completed their reorganization and remounts, the bridges at Bethulie and Norvals Pont had been paired, and the uprising in Cape Colony subdued. General Clements had reached Bloemfontein, while Generals Gatacre and Brabant were moving gradually on Ladybrand to secure Roberts' right flank.

In Natal, Botha held his intrenched position in the Biggarsberg with about 12,000 men, his main body north of Helpmakaar, with strong detachments at Glencoe and One Tree Hill (Road Junction Pass), while 2,000 Orange Boers held the Drakensberg passes.

General Buller, with 40,000 men, occupied a position north of Elandslaagte and on the Sunday River. His advanced position was of great importance, as it was geographically 60 miles farther north than Bloemfontein.

In the north of the Transvaal a new movement was being planned. With the consent of Portugal, the Rhodesian Field Force, under General Sir F. Carrington, 5,000 strong, composed of Colonial horse (mostly Australian bushmen) was to land at Beira and be transported by rail to Rhodesia.

The army was entirely reorganized, both the divisions under General Roberts and those in Natal (see Appendix); and Hart's brigade was sent from Natal to reinforce Brabant in the Orange Free State, while Barton's was sent to the extreme west at Kimberley a little later.

Lord Roberts' original plan appears to have been to advance from Bloemfontein with the main army against the left flank of the enemy at Kroonstad, uniting on the way with a part of Buller's army, opening a way from Natal through the Drakensberg passes, while Methuen was to advance over Boshof and Hoopstad on Kroonstad, thus making a concentric march in three columns. But the enemy's dispositions showed that a very small force was concentrated at Kroonstad, whereas the right flank of the British was seriously threatened, and in Natal, as soon as they learned of the transfer of a part of the 10th division (Hart's brigade) to

the western theatre, the Boers, on the 10th of April attacked Buller, and took Clery's camp, on the south side of Sunday River, completely by surprise, only the arrival of reinforcements saving the situation, but not until after a three days struggle.

Methuen's force, it is true, advanced on its route towards Hoopstad, and reached Zwartskopjefontein. His march was opposed by a detachment of 2,000 under Delarey. On the 20th Lord Methuen retired, followed by Delarey, a serious skirmish taking place between the latter and Methuen's rear guard.

Evidently, then, Lord Roberts could not count on a junction with Buller from Natal, and even Lord Methuen would have difficulty in taking part in the march nortward. Moreover, the main force of the Boers, now east of Bloemfontein, demanded attention before any march north could be made.

The total British forces in South Africa numbered at this time about 200,000 men, distributed over a front of 300 miles, and guarding nearly 1,800 miles of railway. Lord Roberts' army at the center was posted in and around Bloemfontein, occupying also other strategic points, and numbered about 60,000 combatants with 216 guns and howitzers (3½ guns per 1,000 men). The army of Natal numbered about 36,000 combatants, with 96 field guns and howitzers (2¾ pieces per 1,000 men), besides a number of naval guns.

Lord Methuen, in the extreme west, had about 14,000 combatants. The railways and towns of Cape Colony and Natal were protected by about 35,000 combatants. The other fighting forces were those of General Brabant in southern Orange Free State, Colonel Plumer at Gaberones, the garrison of Mafeking, Colonel Parsons at Carnarvon in western Cape Colony, and the new force under Carrington landing at Beira.

### The Siege and Relief of Wepener.

At the same time that De Wet fell upon Reddersburg (April 4th), Olivier, with his column arrived before Wepener. The latter had been occupied by a detachment of Brabant's force under Dalgety, composed of a company of Scotch Mounted Infantry, the Cape Mounted Scouts, the 1st and 2nd Kaffrarian Scouts, —about 2,000 men in all, with 7 guns.

The success of De Wet at Reddersburg should naturally have led to an attempt on Roberts' communications on the Springfield-Bloemfontein railroad, but the appearance of small detachments from Brabant's force, and the approach of the new 3d division under Pole-Carew, induced the Boers to turn eastward.

Olivier, finding Wepener already occupied, left a detachment

in front of it, which was joined by two other commandos retiring from Rouxville and Smithfield, respectively. With the rest of his force Olivier moved southward, and on the 6th of April attacked a detachment of Brabant's troops, composed of 4 companies Irish Fusiliers, 2 companies volunteers and 2 squadrons Border scouts, between Bushmans Kop and the Caledon River, the Witte Spruit and the Basutoland border, opposite Mafeteng, and forced them back on Aliwal North, reoccupying Smithfield with a detachment of his force. On the 9th the Boers besieging Wepener began the attack on that place, the British force occupying the town and the Jammer Berg Drift. On the 10th the latter made a spirited sortie, inflicting severe loss on the Boers. The attack of the Boers was continued, however, and was covered by Olivier at Rouxville and Smithfield against Brabant at Aliwal North, and by De Wet, who concentrated his force at De Wetsdorp after the action at Reddersburg, against a British approach from the north-west.

Meanwhile, for the relief of Wepener, Roberts ordered Rundle's 8th division by rail to Bethanie, thence due east over Reddersburg, by way of Rosendal and Vorlogspoort, on Dewetsdorp; while Brabant, recently reinforced by Hart's brigade from Natal, was directed over Rouxville on Boesmans Kop to force back Olivier's troops. To cover Rundle's left flank Chermside's division (stationed between Bloemfontein and Bethanie) was concentrated at Reddersburg and ordered to Marshoutfontein (17 miles east of the railroad), Knox's brigade holding the railroad in rear, in support.

Rundle left Bethanie on the 13th of April, and Reddersburg on the 16th; but heavy rains made the roads almost impassable, so that he did not reach Wakkerstrom till the 19th, and only came in contact with the Boers (4 miles south of Dewetsdorp) on the morning of the 20th. Chermside occupied Marshoutfontein on the 14th. Brabant reoccupied Rouxville on the 15th.

The vicinity of Dewetsdorp is comparatively high ground, containing the sources of the Modder, the Kaffir, the Koorn Spruit and of several branches of the Caledon emptying into the Orange River. It is much cut up, very difficult for cavalry, favoring the defence and offering many obstacles for the attack. The Boers recognized the fact that it covered their line of retreat to Thaba 'Nchu and Ladybrand, and consequently fortified it with great care. The right of their position was protected against an attack from Bloemfontein by the Leeuw Kop (16 miles south-east

of Bloemfontein), which was occupied by the left flank of the Boer forces encircling Bloemfontein on the east. The front of their position at Dewetsdorp faced south-west. The total Boer forces at Wepener and Dewetsdorp amounted to 8,000 men, with 15 guns.

Rundle, deciding that the position was too strong to attack in front, deployed the mounted infantry and yeomanry in front, and sent Brabazon with the cavalry to outflank the left of the Boer position. The Boers retired their left wing, but took up a new defensive position, while Rundle entrenched on the ground gained.

Meanwhile, Brabant reached the enemy's position at Bushman's Kop, 18 miles south of Wepener, on the evening of the 21st.

De Wet's force at Dewetsdorp resisted Rundle's advance, consequently Roberts despatched Pole-Carew's division from Bloemfontein on the 22nd, and two brigades of cavalry under French, to relieve the situation. They reached Leeuw Kop (near Bloemfontein) the same day, the latter being abandoned by the Boers on their approach, and continued to Tweede Geluk (24 miles north-west of Dewetsdorp).

Brabant turned the flank of the Boers at Bushman's Kop and pushed on to within 8 miles of Wepener.

At this time (23d) General Roberts instituted a general movement against the Boer position to the east of Bloemfontein, sending the mounted infantry under Hamilton against the waterworks and Thaba 'Nchu, supported by Smith-Dorrien's brigade.

To occupy the enemy in front and to prepare for his advance toward Kroodstad, Maxwell's brigade of the 7th division at Karee Siding moved eastward and took possession of the hills commanding the wagon bridge over the Modder River at Kranz Kraal, 8 miles east of the railway, on the 23d of April.

On the 24th Hamilton occupied the waterworks at Sanna's Post, Smith-Dorrien's brigade 10 miles in rear, the rest of the 9th division in Bloemfontein ready to march eastward, the object being to cut off the line of retreat of the Boers in the south. Brabant made little progress, the Boers holding their own against him and renewing the attack on Dalgety. Pole-Carew reached Roode Kop, 14 miles from Dewetsdorp, on the 24th, French pushing on to the east as far as Grootfontein, in order next day to sieze the Boer line of retreat on Thaba 'Nchu at Vaalbank, 9 miles north-east of Dewetsdorp. Rundle's scouts also came in touch with Brabant's outposts on the Caledon.

The Boers, on the night of the 24th, however, abandoned their

positions at Dewetsdorp and Wepener and retired on Thaba 'Nchu and Ladybrand, respectively. Brabant pursued along the Basuto Land border, while French and Rundle followed along the Dewetsdorp–Thaba 'Nchu road. Pole-Carew returned to Bloemfontein, as reserve. On the 27th French reached Thaba 'Nchu, joining there the forces of Hamilton and Smith-Dorrien, Rundle also arriving later in the day. The Boers, however, made good their escape and joined their forces near Ladybrand.

The pursuit of the Boers was continued during the 26th and 27th of April. The district of Moroka through which the Thaba 'Nchu–Ladybrand road passes is mountainous country in the form of a bastion with its base and higher ground near Ladybrand, its point and lower ground towards Bloemfontein. East of Thaba 'Nchu the ground changes from its comparatively low hilly character to the westward to broader and higher reaches to the eastward, the latter forming excellent defensive positions, very difficult for cavalry. In the latter the Boers (under De Wet), retiring from Thaba 'Nchu, took up a strong position. French, with his usual energy attacked, but was compelled after a fruitless engagement to retire on Thaba 'Nchu. On the 28th and 29th the advance was continued, but this frontal attack was effectively resisted by the Boers. The British attempted to turn the Boer left flank, but the right flank of the latter was so active that little headway could be made, until the British decided to make a wide detour and attempted to strike through the Houtnek Pass, about 12 miles north of Thapa 'Nchu, which was held by a Boer force under Botha. This was accomplished by Hamilton with the mounted infantry, supported by Broadwood's brigade, and Bruce Hamilton's infantry brigade (21st), on the 2d of May, and the Boers retired towards Winburg. In this action the Boers lost 12 killed, 40 wounded and 26 prisoners. Hamilton rested at Jacobsrust by Lord Roberts' orders, as he had been fighting for seven days out of the past ten.

Meanwhile Roberts resumed the general advance on Kroonstad, and these troops joined his right flank. The Boers, on the 3d and 4th, retired over the Leeuw River (east of Thaba 'Nchu), followed by Rundle and Brabazon to that stream, when the latter came in touch with Brabant. The posts of the 3d division left at Thaba 'Nchu returned to take charge of the line of communications.

### LORD ROBERTS' CAMPAIGN.

#### The Advance on Kroonstad.

The country between Bloemfontein and the Vaal River is a rolling plain, with low ridges crossing in the northern portion,

showing occasionally the characteristic South African table mountain.

The railroad runs in a north-eastern direction for 125 miles without a curve, over nearly level country, which is treeless, with streams only in the rainy season, and only grass and low bushes visible over the broad plain. Few houses, and these only isolated dwellings and Kraals, are met with, and the country furnishes nothing for the support of troops.

But, while the British army will have to depend entirely on the supplies it carries along, the advance offers no difficulties, since the railroad, wherever it has been destroyed (as at the low bridges over the Modder, Vet and Zand rivers) is easily repaired. There are no places for defensive positions except at Brandfort, Winburg and Ventersburg, where there are considerable elevations; but all these can be turned, especially since the entire country is practicable for cavalry or mounted infantry. The innumerable Spruits are far more troublesome to an army than the Kopjes, because in the rainy season they swell so suddenly, and are rarely bridged, while in the dry season they form excellent defensive positions for the Boers.

The total number of British troops in South Africa on the 21st of April amounted to about 210,759, including officers, but after deducting the non-combatants (13,000), the troops on the lines of communications (40,000) and the sick (about 23,670), the total fighting strength was about 134,000, stationed as follows:

| | |
|---|---|
| Under Roberts directly in Orange Free State (including garrisons) | 66,000 |
| Under Methuen and Hunter at Kimberley, Boshof and Fourteen Streams | 20,000 |
| Under Parsons in western Cape Colony | 10,000 |
| Under Plumer, north of Mafeking | 2,000 |
| Under Baden-Powell, in Mafeking | 1,000 |
| Under Carrington, in Rhodesia | 5,000 |
| Under Buller, in Natal | 30,000 |

The total Boer forces in the field amounted to about 50,000 men, distributed as follows:

| | |
|---|---|
| South-east of Bloemfontein | 8,000 |
| At Smaldeel | 3,000 |
| At Brandfort and Karee Siding | 5,000 |
| Ladybrand | 1,500 |
| East of Bloemfontein–Springfontein R. R. | 2,000 |
| Between Kroonstad and Winburg | 5,000 |
| | 24,000 |

The rest at Fourteen Streams (6,000), in Natal (14,000), in Barkly West, and in reserve.

Roberts' immediate army was posted as follows, previous to the resumption of the advance from Bloemfontein :*

7th Division, 14th Brigade (Maxwell) at Modder River bridge, beyond Glen.
15th Brigade (C. E. Knox) between the Modder River and Karree Siding.

6th Division, 12th Brigade (Clements) on out-post duty.
13th Brigade (Wavell) north of Modder River, south of Karee Siding.

11th Division, in Bloemfontein.

21st Brigade (newly formed), at Glen.

The position of the cavalry and mounted infantry changed constantly.

The Boers were known to be in force at Karee Siding and on three Kopjes south-east of that point, guarding the road to Winburg.

On April 30th Maxwell's brigade, assisted by Broadwood's cavalry brigade, then at Holzhuisfontein, was ordered to take these Kopjes, which was accomplished before night-fall.

Broadwood's brigade was then directed to move out well to the east, while Hutton was sent to the west, to outflank the Boer position at Brandfort. The 6th and 11th divisions, and the 21st brigade were ordered to advance, following the general direction of the railroad, and to attack the enemy at Brandfort.

On May 2nd Broadwood reached Isabelfontein, 16 miles east of Brandfort, and the Boers retired. The British occupied the position on the 3rd.

The 9th division, Hamilton's mounted infantry and French's cavalry, which had moved on Houtnek Pass and compelled the Boer forces there to retire on Winburg, having accomplished their purpose joined the movement of advance of Roberts' main army. Hamilton reached Welcome (12 miles south of Winburg) on May 4th, and had a skirmish with a retiring Boer column there ; on the 5th he crossed the Little Vet and took Winburg.

Meanwhile, Roberts had engaged the Boers at the railroad crossing of the Little Vet, south of Winburg. Pole-Carew's division (11th) was deployed for the attack, the Boers (under Delarey) on the right bank opposing its advance, bringing several guns in position. The British developed a superior artillery fire, bringing 2 batteries of field guns, four navy guns and 2 siege guns into action, and soon silenced the Boer artillery, but kept up the

fire all afternoon (May 5th). Roberts again turned the enemy's flank, without making a strong frontal infantry attack, by sending Hutton with his mounted infantry and some cavalry and artillery down stream to a ford. The latter was held by a small Boer force with 2 field guns, a howitzer and a Maxim gun, but their artillery was silenced by the British guns, and the Boers retired, losing their Maxim gun and a number of prisoners.

Hamilton reached Winburg about the same time as Broadwood (who advanced along the Bloemfontein—Winburg road). The Boers united their forces, however, and in the night, with the aid of the railroad, effected their retreat. On the morning of the 6th of May Hutton's patrols destroyed the railroad at Smaldeel, but his force was too late to cut off the Boers, although it secured some rolling material for Roberts' further advance.

At Smaldeel the British were compelled to halt for a short period, in order to repair the bridge over the Little Vet, to re-arrange the strategic front and the columns of march, and to await supplies. Hamilton with one brigade of mounted infantry, Broadwood's cavalry brigade and the 9th division constituted the right wing and moved over the Winburg—Kroonstad road; the 7th and 11th divisions and the 21st brigade formed the center along the railroad; and Hutton's brigade of mounted infantry, and the other three cavalry brigades under French, the left, west of the railroad.

On May 7th Roberts had the entire country to the Zand river cleared up by his cavalry and mounted infantry, and found the Boers strongly intrenched on the north bank of the Zand; but indications of retreat induced Hutton to attack with his artillery at Virginia, near the railroad, south of the river, and established the fact that the Boers were abondoning the position.

On May 9th the general advance was resumed by Roberts' army, and on the 10th the Zand was crossed, the troops advancing that day to Ventersburg. On the 11th the army reached the Bloem Spruit, and on the 12th Kroonstad. The Boers retired over the Vaal. President Steyn moved the seat of government to Heilbron.

### EVENTS IN THE SOUTH.

The 8th division (Rundle's), it will be remembered, followed the retiring Boers east of Thaba 'Nchu as far as the Little Leeuw Spruit. On the 9th of May, not being able to penetrate to Ladybrand eastward, Rundle turned north along the Leeuw, and after a number of minor affairs with stray Boer commandos, reached Mequathings Nek (18 miles north-west of Ladybrand) on the

16th, and Clocolan (20 miles north-east of Ladybrand) on the 17th. After these points were taken, Brabazon with the Yeomanry was able to push forward to Ladybrand.

KROONSTAD.—*Armée et Marine.*

EVENTS IN NATAL.

Buller also resumed the offensive on the 9th and advanced against the Boer position in the Biggars Berg. The 2d division and Dundonald's cavalry marched towards Helpmakaar, while Bethune's mounted force was sent in the direction of Greytown

to mislead the enemy. On the 12th the 5th division moved eastward from Elandslaagte and occupied Indoda Mountain, eleven miles away, to cover and support Buller's movement, while Bethune, turning northward, made for Pomeroy.

The enemy's position was a few miles south-west of Helpmakaar. On the 13th the British infantry attacked it in front, the cavalry turning the right flank, and Bethune's force operating on the left and rear.

The Boers (now about 7000 strong) retired over Helpmakaar, firing the dry grass as they went. Dundonald's cavalry pursued, and the army occupied Dundee and Glencoe on the 15th; on the 17th it reached Dannhauser, with its advanced patrols at Newcastle. The Boers fell back over Laings Nek and De Jager's Drift on the Buffalo River. They destroyed the waterworks at Newcastle, and the bridge over the Ingogo, and blew up the tunnel at Laing's Nek. Buller sent Clery and Dundonald as advance guard towards Laings Nek (Clery detaching Hildyard's brigade towards Utrecht), and ordered Lyttleton towards Vryheid to turn the Boer left flank.

EVENTS IN THE EXTREME WEST.

Towards the end of April Douglas' brigade, which had advanced as far as Zwartskopjefontein had been forced to return to Boshof by Delarey, and Paget's brigade was still striving to force a passage over the Vaal near Fourteen Streams. Meanwhile, a detachment of mounted troops, about 1500 strong, under Colonel Mahon, attempted to cross the Vaal below Barkly West, in order to turn the Boer west flank and thus reach Mafeking by forced marches; this force reached Taungs on May 7th, and Vryburg on the 9th.

Colonel Mahon's force consisted of picked cavalry and included a detachment of Queenslanders and Canadians drawn from Carrington's Bushmen at Beira. This detachment left Beira on May 5th, went by rail to Salisbury and by coach to Buluwayo, where it arrived May 8th, then by train to Oatsi, arriving May 11, then marched for twenty-two hours to join the main column on the 12th.

Early in April Hunter's division (10th) was taken from Natal and transferred to the western theatre, Hart's brigade being sent to reinforce Brabant at Aliwal North, while Barton and the artillery were sent to Kimberley, where they were joined by Hart after the relief of Wepener. The object of thus reinforcing Methuen was to enable him to cross the Vaal and relieve Mafeking.

While Paget made a demonstration at Warrenton, Hunter

endeavored to cross the Vaal farther west, at Windsorton, about 27 miles below Fourteen Streams, then to turn on Fourteen Streams and roll up the Boer position. On the 5th of May he effected a crossing, and on the 9th he attacked the right flank of the Boer position at Fourteen Streams, while Paget advanced against its front at Warrenton. The Boers were forced to retire. Hunter sent Barton's brigade towards Mafeking, while he with the other brigade moved towards Bloemhof, and at the same time Methuen advanced in the direction of Hoopstad. Delarey from Zwartskopjefontein moved north towards Mafeking, while the Boers from Fourteen Streams retired on Klerksdorp. Hunter occupied Christiania on the 13th of May.

#### The Relief of Mafeking.

Meanwhile, the column under Mahon advanced by forced marches to the relief of Mafeking. After passing Vryburg the column made a detour to the west to avoid a Boer force at Pudimoe Siding, 10 miles north of Taungs, and again on the 13th, at Setlacoli, a similar detour was made to avoid a column from Maritsani Station, which was that of Delarey, who had moved north to cover the siege. At Kraiipan the British column was heavily attacked, but the Boers were finally repulsed. On the 15th Mahon joined Plumer at Janmasibi, 20 miles west of Mafeking, and on the 16th they attacked a Boer force of 1500, nine miles west of the investing lines. The Boers were defeated and retreated eastward, and on the 17th Mahon entered Mafeking. The Boers had made a last attack on Mafeking on the 12th, in which they were completely defeated, Eloff, the commander, and 120 men being taken prisoners.

The siege of Mafeking had lasted 217 days.

On the same day, May 17th, Methuen entered Hoopstad, and Hunter left Christiania for Bloemhof.

### LORD ROBERTS' CAMPAIGN.

#### The Advance on Pretoria.

At Kroonstad the army of invasion rested in order to secure its lines of communication, *first*, as regards their organization, *secondly*, as regards their protection, since a number of Boer commandos still hovered about the flanks of the British front as well as their line of advance.

In the movements instituted for the protection of the flanks, Hutton on the left succeeded in capturing a small Boer detachment at the mouth of the Olter Spruit, on the Vaal, while Broadwood on the right occupied Lindley on the 17th. These mounted troops on the extreme flanks pushed out detachments toward the

Rhenoster River, and found the Boers on its north bank. Hamilton and Broadwood moved out from Lindley on the 9th and had a series of engagements with a Boer force under DeWet retiring before them, reaching Heilbron on the 22nd. French and Hutton on the left reached Borman on the Rhenoster on the same day, and Prospect, 5 miles north of the river, on the 23d.

At the same time, Hunter in the west advanced to Vryburg, which he reached on the 23d.

The general advance was resumed on the 22d, the army reaching Honing Spruit Station, 20 miles north of Kroonstad. on that day, and continuing the advance on the 23d. The Boers, threatened on both flanks, retired, after destroying the Rhenoster bridge and the railroad.

After passing the Rhenoster Lord Roberts decided to concentrate his army more, and to put all the cavalry on the left flank. The interval between the two flanking columns (nearly 50 miles) had proven too great for concerted action, so that, although the Boers were easily maneuvered out of their positions, they were always enabled to retire with all their artillery and baggage. Hamilton and Broadwood were directed to join French and Hutton on the left wing, the right being covered by Colonel Henry's mounted infantry only.

French and Hutton reached Parys on the 24th, and part of their forces crossed the Vaal there; Hamilton and Broadwood stood at Wolvehoek north of Heilbron station, and Roberts was close up to Wolvehoek. On the 25th the main part of the forces of French and Hutton crossed at Lindequees Drift, 10 miles west of Vereeniging, Broadwood crossed at Wonder Water Drift north of Boschbank (8 miles west of Vereeniging), while Hamilton stood at Boschbank; Roberts swung away from the railroad, moving on Boschbank. Broadwood's brigade secured Wonder Water Drift, three miles above Lindequees Drift, and there covered the passage of Hamilton's column on the 26th.

Colonel Henry, constituting the advance guard, seized Viljoen's Drift (south of Vereeniging), but one span of the railway bridge was blown up by the Boers, here commanded by Lemmer. On the 27th Roberts' army crossed the Vaal there, the 3d cavalry brigade (Gordon), which had crossed at Engelbrecht Drift the day before, covering the right flank.

The extent of the front of Roberts' army by these movements was reduced to 25 miles.

Immediately after passing the Vaal, and entering the Transvaal or South African Republic, Lord Roberts announced the

annexation by Great Britain of the Orange Free State, under the name of the *Orange River Colony.*

On the 27th French and Hamilton, operating to the westward, reached Van Wyksrust, 30 miles south-west of Johannesburg, while Roberts' main army on the 28th advanced to Klip River, 15 miles from Johannesburg, continuing on the 29th to Germiston, 10 miles east of Johannesburg. There Roberts secured possession of the junction of the road to Natal over Heidelberg, and that of the Johannesburg–Klerkdorp road.

Colonel Henry with his mounted infantry, supported on the right by the 3d cavalry brigade, had orders to seize Natal Spruit and Elandsfontein at all cost. Pole-Carew and Tucker advanced along the railroad. Natal Spruit was first taken then Elandsfontein, thus turning the Boer right.

Roberts here detached the 9th division for service in guarding the communications, retaining only the 11th and 7th divisions.

On the 30th Lord Roberts' army surrounded the city: the 7th division and Gordon's cavalry on the north, Hamilton on the west at Florida, French on the north-east, the 11th division and the heavy artillery remaining in Germiston. On the 31st the city surrendered, Roberts having agreed to allow its complete evacuation by the armed burghers. The Boers had left much rolling material and even a train-load of coal in their hasty retreat, and the mines were found undisturbed.

The British army had covered the distance between Kroonstad and Germiston, nearly 160 miles in 8 days, at the rate of nearly 20 miles a day, repairing roads, railroads and bridges as they went, a remarkable performance.

In Pretoria Lord Roberts' victorious advance created consternation. President Krüger and the principal officials fled on the 29th of May to Machadodorp, a station on the railroad to Lorenzo Marques. General Botha, however, was in Pretoria on the 31st, encouraging the Boers and endeavoring to incite them to further resistance, but with poor success.

Roberts, therefore, hastened his advance in order to take advantage of the confusion and to prevent the Boers from forming and executing new plans of resistance. His army rested on June 1st, and on the 2nd, leaving the 14th brigade (Wavell's) in Johannesburg, he resumned his advance, the left flank covered by Hamilton, the extreme left guarded by French and Hutton pushed out towards Schoewan.

On June 4th the British came in contact with the Boers at Six Mile Spruit (Hennops River), just south of Pretoria. The

mounted infantry and Yeomanry dislodged the Boers from their first position, but after pursuing them for nearly a mile came upon their real position, protected by guns. The British heavy guns, which had been placed well to the front for that purpose, came into action, supported by Stephenson's brigade and drove the Boers out of their position.

The latter then attempted to turn the British left flank, but were resisted by the mounted infantry and Yeomanry and Maxwell's brigade, and finally Roberts directed Hamilton, 3 miles to the west at that time, to turn in to the gap between the two columns. The Boers were driven back to Pretoria. Roberts bivouaked on the field, 4 miles from Pretoria. French, with the 3d and 4th cavalry brigades and Huttons's mounted infantry, was north of Pretoria, Broadwood between French and Hamilton, and Gordon was watching the right, near the railway bridge at Irene Station, which had been destroyed by the Boers.

The strength of the latter at Six Mile Spruit was still about 10,000.

Hamilton pursued the Boers on the evening of the 4th to within 2000 yards of the town, through which they retreated. In the morning the town was surrendered. The Boer forces, under Louis Botha, taking their guns with them, had retired to the eastward and northward. Most of the English prisoners (4500) were left by them at Waterval.

The surrender of the Transvaal capital closes the fourth act of the drama.

### EVENTS IN THE SOUTH.

The guarding of the railway south of the Vaal was conducted by Rundle, Brabant, Clements and Methuen, holding a chain of posts from Heilbron to Ficksburg, 110 miles.

Kelly-Kenny remained at Bloemfontein.

Rundle and Brabant continued maneuvring against the Boer commandoes between Ficksburg and Bethlehem. On May 24th, Colville standing at Winburg, they reached Trommel, and on the 28th they had a sharp engagement with a Boer force at Senekal. On the 29th Rundle advanced south-east from Senekal to draw the Boer forces from Lindley, where a force of Yeomanry was hard pressed. Lindley was occupied by the British, but on the 31st of May the 13th battalion Yeomanry under Colonel Spragge was surrounded and captured by a superior Boer force. Methuen from Kroonstad had been ordered to the rescue and marched 44 miles in 25 hours, but arrived too late. He attacked the Boers, however, and routed them.

### EVENTS IN THE EXTREME WEST.

In Griqualand West a revival of the rebellion so recently stamped out took place. Warren, with 700 men, was surrounded at night on May 29th, surprised and attacked by 1000 rebels, while encamped at Faberspruit, 12 miles from Douglas. The Boers were finally repulsed, but with heavy loss to the British.

Hunter was occupied in repairing the railway to Mafeking. On May 24th Hart was at Fourteen Streams, on the Vaal, Barton at Taungs, Hunter at Vryburg, Baden-Powell at Mafeking, and Carrington at Marandellas. On May 28th Plumer occupied Zeerust, and on the 30th Hunter was at Khunwana, 40 miles south of Mafeking, and early in June was marching unopposed over Ventersdorp on Pretoria.

### EVENTS IN NATAL.

Buller was detained at Newcastle repairing the railroad.

On May 18th a squadron of Bethune's horse (500 men) was detached to march from Dundee by Vantis Drift, showing their force in Nqutu, then to rejoin the main body at Newcastle. On their return they were ambushed by the Boers and lost 27 killed and 11 prisoners.

On May 19th Clery's division encamped at Ingogo, 12 miles north of Newcastle, while Dundonald reconnoitred to Laing's Nek. On the 21st Buller's scouts crossed the Buffalo into the Transvaal.

Hildyard's (5th) division joined Buller at Newcastle on the 27th of May, and was at once sent out to seize Utrecht, while Lyttleton was ordered to move on Doornberg and Vryheid. The object of these movements was to turn the strong Boer position beyond Laing's Nek.

The defile at Laing's Nek was opened and the tunnel there repaired.

On June 2nd Hildyard joined the main force from Utrecht. Lyttleton was at Coetzee's Drift, protecting the right flank.

The Boers, under Christian Botha, still numbered 10,000 men, and successfully opposed Buller's advance.

### COMMEMTS.

#### The Advance on Bloemfontein.

The battles of the war thus far, not including that of Paardeberg, fall into three groups of four each :

The first group embraced the actions in Natal at Glencoe, Elandslaagte, Rietfontein and Nicholson's Nek,—three tactical successes culminating in a grave disaster. The second included the encounters in the west, of Belmont, Gras Pan, Modder River

and Magersfontein,—again three victories followed by a serious repulse. The third group comprised the battles on the Tugela, Colenso, Spion Kop, Vaalkranz and Pieter's Hill,—three desperate repulses, succeeded by a final victory.

The invasion of the Free State by Lord Roberts rendered possible the forcing of the Boer lines on the Tugela, by drawing off a portion of Joubert's army, but the capture of Pieter's Hill decided the campaign in Natal. In tactics this battle also illusstrates the best modern ideas on the subject, namely, the combined frontal and flank attack, and is a perfect example of the proper execution of such a movement and action.

After Cronje's defeat the Boer army should either have struck a decisive blow in Natal to counteract Lord Robert's victory at Paardeberg, or, if they had to give up the siege of Ladysmith, their only chance for any decisive results was to concentrate all their available forces as rapidly as possible at Brandfort and Winburg in order to strike a decisive blow against the victorious army of Lord Roberts.

The occupation of Bloemfontein,—turning aside from the direct route against the enemy's army—by Lord Roberts was a sound movement strategically, in which the moral effect of occupying the enemy's capital played but a secondary part. His strategic purpose was to get in communication with the columns of Brabant, Gatacre and Clements, to secure a strong base and the railroad as a line of supply and communication, and to reestablish on a normal footing the system of relays and intercommunication of the parts of his army. Moreover, by taking the southerly direction along the Kraal Spruit any further intrenched positions of the enemy would be turned by the mere advance of the army.

Knowing the state of French's cavalry, it is difficult to criticise the tactics of the advance on Bloemfontein. Their deeds, considering the circumstances, are rather the subject for praise and wonder. Nevertheless, it was a mistake in reconnoisance to allow Porter's brigade at Poplar Grove to fall into the zone of a Boer position which had not been properly reconnoitred. Moreover, as another result, his turning movement was not at first sufficiently extended to strike the actual rear of the Boer flanks in the first place, so that Robert's success was not complete, and the Boers were ready to oppose him again on the 10th.

Again, at Driefontein, the British came upon the Boer position unexpectedly, and were forced at first to make a frontal attack. They failed again to cut off the Boers, or to gain a decisive vic-

tory. One great cause of the British difficulties in reconnoisance, aside from the worn-out condition of the cavalry, was the lack of good maps, those of the Intelligence Division being remarkably poor, but the greatest element in their failure to bring about decisive actions was the remarkable mobility of the Boer troops, which they made full use of at this time in the tactics which they adopted, namely, to stand and fight till the tide begins to turn against them, and then rapidly to retire beyond reach. The forced march of the division of Kelly-Kenny across the hot plains, followed by six hours of hard fighting, was a performance deserving to rank among the finest of this kind.

After the fall of Bloemfontein there were three positions available for the Boer forces to make a defensive stand: at Brandfort, about 35 miles north of Bloemfontein; near Winburg, about 30 miles farther north; and at Ventersburg, about 30 miles still farther.

On the east these positions rest on considerable heights, but on the west they can all be turned, for which purpose the numerical superiority of the British would of course be taken advantage of. The first position (at Brandfort) could have been occupied immediately after Cronje's defeat, but after the fall of Bloemfontein it was no longer possible to concentrate the Boer army from Natal there, but it was still practicable to assemble it at Ventersburg or Kroonstadt, holding the passes of the Drakensberg by a few thousand men. Moreover, after the occupation of Bloemfontein, the flanks of the position at Brandfort could readily have been threatened from Boshof, which Roberts had previously ordered occupied.

It is evident that, unless a decisive blow could be struck at once in Natal, it was useless for the Boers to hold on there, because the advance of Lord Roberts north from Bloemfontein would at once render the position of the Boer army on the Biggarsberg untenable, and force the latter to retreat over Laingsnek into the Transvaal domain. No doubt, the desire to hold the British beyond their own borders as long as possible influenced the Transvaal Boers to keep their main army in front of Buller, and to attempt to delay Roberts by means of a small but active force in the west.

### The Strategy of the Boers.

The Boers, however, contrary to all expectation, adopted a more daring plan than that of concentrating at Kroonstad. They occupied the difficult hill country to the east and south-east of Bloemfontein, not over 40 or 50 miles from that capital. This

was a bold step to take, but it promised results, for it placed on Lord Roberts' flank a force which would either compel him to give up his advance and turn against it towards Ladybrand, or, if he persisted in advancing, to leave his long line of communications exposed to a flank attack. The moral effect of occupying a position so near to the British army was also very great, and restored the courage of the Orange Free State Boers.

By the death of Joubert the Boers lost their ablest general, and, coming as it did just after the capture of Cronje, the blow fell doubly hard. But the new generals, Botha, Olivier, De Wet, and others appeared to fill their places remarkably well, as shown by the actions immediately after Joubert's death and for some time thereafter; indeed, the fact that they were younger men in general probably was an advantage in itself, considering the new and more active mode of warfare demanded by the circumstances, and adopted by the Boers.

This new strategy of the Boers led to innumerable minor engagements, but finally, early in April, they began a movement on a larger scale. While part of their forces made an attack at Brandfort against the center of Lord Roberts' line, a large force undertook a raid around his right flank towards Wepener, with a view to striking the British communications in rear and to gather up as many of the burghers as possible to swell the ranks of their army, while at the same time another force was gathering in the west at Paardeberg to move against Roberts' left flank. Moreover, farther west still, at Barkly West, Fourteen Streams, and along the north bank of the Vaal the Boers were threatening an advance on Kimberley. Another great object of this movement to the rich country of Southern Orange Free State was to gather in supplies, especially the harvest for which the district is noted.

While the spirit of this movement was strategically *offensive*, even to actual contact with the enemy (as at Reddersburg and Smithfield), its *tactical* execution failed entirely, for, instead of taking up the tactical offensive and attacking the British with determination, they split up their forces and engaged in a number of minor affairs which had no real connection with the original object of their strategical advance. Again did their tendency to a tactical defensive prevent them from reaping the rewards of their strategical *offensive*.

### The Actions Around Bloemfontein.

The escape of Van der Post's column through the British lines at Poplar Grove, and that of Olivier's and Grobler's along the

Basutoland border must be attributed *first*, to the fact that Roberts' cavalry was used up and the necessary remounts had not yet arrived, and *secondly*, to the necessity of slow movement of the British columns following them from Cape Colony, this slowness being demanded in order to pacify the country passed over. The British columns were thus prevented from keeping in touch with the Boer columns, which enabled the latter to escape.

In the action at Karee Siding the condition of the cavalry evidently prevented a more complete victory.

The surprise of Broadwood's train at Koorn Spruit and his command at the waterworks is another example of neglect of outpost and reconnoisance duty, at least of an effective kind. Broadwood knew that the enemy was in the vicinity in force, for he had himself reported the fact to General Roberts and had acted on the information by retiring from Thaba 'Nchu.

The capture of the command at Reddersburg was due to insufficient equipment at the outset, since no artillery was assigned to this column, and for this neglect General Gatacre was properly held responsible. Moreover, it would seem that with a proper system of transmitting information General Gatacre should have known of the action going on within 8 miles of one of his permanent posts (at Bethanie) long before he received his order from General Roberts; and after he received that order, since he had the railroad available to Bethanie, and only 8 miles to march, it would seem that the relief force should also have arrived earlier. In addition, however, there was again the usual neglect of proper outpost duty, otherwise so complete a surprise would have been impossible.

### The Relief of Wepener.

The measures taken by Lord Roberts for the relief of Dewetsdorp and Wepener were finally effective so far as to cause the retreat of the Boers as soon as their line of retreat was threatened, but failed in effecting their capture. This was due mainly to the condition of the British troops, and it is to be noted that other indications point in the same direction. A careful analysis of the events will make this clear.

In the first place, the ordering of Brabant, Hart and Rundle against Wepener and Dewetsdorp was not dictated by strategical considerations, but merely to relieve the British force at the former of these two points, and to support it against great odds. The reinforcement of Rundle's troops by Pole-Carew and French was originally of a similar character.

In the next place, the movement finally made against the Boer

lines of retreat (by Hamilton's command) was made by an entirely inadequate force and too late to be effective in capturing the agile Boers. It is evident that Roberts simply did not have his troops ready any sooner for taking the field, and this view is supported by the fact that the troops first selected were those which had not participated in the hard march to Bloemfontein, and also by the fact that as soon as possible Pole-Carew was sent back as a reserve to Bloemfontein to be available for any possible movement of the Boers from the north-east or north-west, or to meet any emergency in the east or south-east.

Finally, the pursuit by the British after the Boers abandoned Dewetsdorp and Wepener was too slow to insure success, and this again must be attributed to the condition of the troops, more especially as to supplies.

The explanation of this state of affairs after so long a rest in the case of the troops at Bloemfontein is to be sought not only in the effects of the hard marches from Modder River to Bloemfontein, but more especially (and this applies also to the new reinforcements recently arrived) to the fact that the British rolling material for the *narrow* gauge road of supply had all to be prepared before the system of supply could be fully organized.

Nevertheless, some share of the blame must fall on the apparent lack of good training of the new troops in modern war movements.

#### The Advance on Kroonstadt.

The decision of Lord Roberts to advance again after the capture of the Kopjes south-east of Brandfort on the 4th of May was good judgment and fine strategy. The movements of his entire army were thus combined on a single object, and no time was lost in forming a new front, but the parts came up into line as they moved forward on their natural routes, and in such a way as to embody a turning movement at the same time.

But in turning the enemy's position at Vet River with cavalry (or mounted troops) on both his flanks it does not appear clear why Hamilton or Hutton did not strike the rear of the enemy and break up the railroad to prevent his retiring. In all probability Hamilton was not sufficiently informed on reaching Winburg of the position in front of Roberts, and so could not know how effective such a measure might be, and Hutton evidently obeyed his orders too literally, and did not take advantage of the opportunity offered till too late.

At Smaldeel the question naturally arose as to the propriety of attacking in rear the Boer detachments occupying the Drakens-

berg passes, because Winburg, on account of the connections and communications, was the nearest point along the railway from which to accomplish this. To have done this, however, would have necessitated leaving the railway again, and besides would have offered the Boers an opportunity to attack the British in flank. In view of these facts, then, and the additional one that Buller was holding a large Boer force idle in front of him, the strategy of Lord Roberts in continuing his advance along the railroad must be regarded as sound.

Of course, the latter movement still presented some difficulties, because the Boers retiring from the Moroka district might effect in the vicinity of Bethlehem, a junction with those opposing Roberts' advance directly, and then compel the British to fight with their front to a flank. But the character of the opposition thus far met with did not indicate such mobility, determination or strategic ability on the part of the Boers. It was with a view to preventing such action on the part of the latter that Roberts, on May 7th, had such an extended reconnoissance made by his cavalry and mounted infantry to make sure that the Boers were retiring northward beyond the Zand River.

The prompt advance of Lord Roberts beyond Smaldeel was masterful strategy. The moral effect was in itself very great: most of the Orange Boers returned to their farms and the Transvaal Boers declined to fight any longer in the Orange Free State. But the strategic results were greater still, because it gave Roberts practically control of the line Durban—Bethlehem, and Durban—Johannesburg. The advance, moreover, put these three theatres in actual strategic relation with one another, for Buller in Natal, and Hunter and Methuen in the vicinity of Kimberley, moved out at the same time, and Roberts' short halt in Kroonstad was mainly to adjust the parts of this line.

### The Advance on Pretoria.

The advance of Roberts from Kroonstad to Johannesburg, was conducted at first on a broad front (about 50 miles), but it soon become evident that, while such an extent of front facilitated the turning of the Boer positions strategically, it did not fulfil the tactical conditions necessary for capturing the Boers or for forcing them to stand and fight a decisive action, because concerted action between the turning wings was impossible. Consequently, after passing the Rhenoster, the width of front was reduced to 25 miles, and all the cavalry was put on the left flank. The Boers then could escape only by giving up practically all resistance.

This march to Johannesburg, considering its distance, the character of the country, the size of the army and the destroyed bridges, railroads and roads, was a splendid achievment, and illustrates the grand qualities of the British in marching capacity, in their ability to repair bridges, railroads and wagon roads, in their utter contempt for the danger of an enemy hovering on their lines of communication in rear, and in their determination to reach their objective.

The turn to the west before crossing the Vaal was sound strategy, for the Vaal, unlike the other rivers in this section in the dry season, is not fordable exept at a few points, and the position at Vereeningen was a very strong one to force, and required passing over the bridge there.

The strategy of Roberts' campaign was brilliant and eflective, and the opening of Laings Nek by Buller and the advance of Hunter over Ventersdorp on Pretoria promished to furnish him the necessary reinforcements. Nevertheless, the escape of the Boers at Johannesburg and again at Pretoria give to the results an element of incompleteness, especially as the enemy retired to the difficult mountain country—the Lyndenburg District.

Roberts' turning movement in both these cases was by his left; had he turned to the east he would have forced them to fight at both places. However, it must be remembered that Roberts counted on Buller's advance from Natal, which the latter was unable to effect; moreover, his main object was to keep the Boers moving by the rapidity of his strokes, and at both the above mentioned places the turning of the western flank was far the easier, hence the more quickly accomplished.

*Strategically*, then, his march marked the great commander, who takes a comprehensive view of the entire situation, and attains his object, in spite of mishaps in insolated parts of the theatre. *Tactically* he could not reap the the full harvest of his strategy because of Buller's difficult advance from Natal and the disturbances around Lindley threatening his line of communications in rear: the necessity for rapidity of action was greater than that for perfection in tactical disposition.

# APPENDIX.

### British Casualties of the War to March 9th.

| | *Officers.* | *Men.* |
|---|---|---|
| Killed | 132 | 1,583 |
| Died of wounds | 38 | 309 |
| Missing and prisoners | 138 | 3,191 |
| Died of disease | 22 | 793 |
| Died of accidents | 2 | 20 |
| Sent home as invalids | 83* | 2,428* |
| | 415 | 8,324 |
| Total | 8,739 | |

### Changes in Command.

General Joubert died in Pretoria, March 27.

General Louis Botha succeeded to the command of the Transvaal Boers, while President Krüger assumed the command-in-chief of the Boer troops.

General Clery returned to the 2nd division, March 30.

General White left Ladysmith on March 9th, to return to England for rest and recuperation. General Lyttleton took command of the Ladysmith garrison, with Howard and Knox in command of the brigades.

The 10th division was placed under General Hunter. It comprised the 5th and 6th brigades.

April 15, Gatacre was recalled to England, and Pole-Carew succeeded him. Colonel Inigo Jones received the Guards Brigade.

### Organization of Lord Roberts' Army.

*Before the Advance on Bloemfontein.*

1st Division.
Methuen.

1st Brigade. Pole-Carew. — 9th Brigade. Douglas.

6th Division.
Kelly-Kenny.

13th Brigade. Knox. — 18th Brigade. Stephenson.

7th Division.
Tucker.

14th Brigade. Chermside. — 15th Brigade. Wavell.

9th Division.
Colville.

3d Brigade. Colville. — 19th Brigade. Macdonald.

*Artillery.*

11 field batteries, 2 howitzer batteries, 4 navy 4.7″ guns, 4 navy 12-pounders, 3 Vickers-Maxim automatic guns (37 mm.).

*Mounted Troops.*

Cavalry Division.
French.

1st Brigade. Porter. — 2d Brigade. Broadwood. — 3d Brigade. Gordon.

Mounted Infantry Division.

1st Brigade. Hannah. — 2d Brigade. Ridley.

7 horse batteries.
1 balloon section.
6 companies engineers.

The 8th Division (Rundle) landed at East London March 30th, and was sent to the front at once, reaching Springfontein April 12th.

* Includes some of the wounded.

*Before the Advance from Bloemfontein.*

| | | | |
|---|---|---|---|
| 1st Division. | | 3d Division. | |
| Methuen. | | Pole-Carew.* | |
| 1st Brigade. | 2nd Brigade. | 22nd Brigade. | 23d Brigade. |
| Douglas. | Paget. | R. E. Allen. | W. G. Knox. |
| 6th Division. | | 7th Division. | |
| Kelly-Kenny. | | Tucker. | |
| 12th Brigade. | 13th Brigade. | 14th Brigade. | 15th Brigade. |
| Clements. | Wavell. | J. G. Maxwell. | C. E. Knox. |
| 8th Division. | | 9th Division. | |
| Sir Leslie Rundle. | | Colville. | |
| 16th Brigade. | 17th Brigade. | 3rd Brigade. | 19th Brigade. |
| Campbell. | Boyes. | MacDonald. (Highlanders) | Smith-Dorrien. |
| 11th Division. | | | |
| (vacancy) | | | |
| Guards Brigade. | 18th Brigade. | 21st Brigade. | |
| I. R. Jones. | Stephenson. | (newly formed) Bruce-Hamilton. | |

*Cavalry Division.*

French.

| | | |
|---|---|---|
| 1st Brigade. | 2nd Brigade. | 3rd Brigade. |
| Porter. | Broadwood. | Gordon. |

*Independent.*

4th Brigade.
Dickson.

*Mounted Infantry.*

Hamilton.

| | |
|---|---|
| 1st Brigade. | 2nd Brigade. |
| Hutton. | Ridley. |

**The Natal Army.**

April 15.

| | | | |
|---|---|---|---|
| 2nd Division. | | 4th Division. | |
| Clery. | | Lyttleton. | |
| 2nd Brigade. | 4th Brigade. | 7th Brigade. | 8th Brigade. |
| Hildyard. | Cooper. | W. F. Kitchener. | Howard. |
| 5th Division. | | 10th Division.† | |
| Warren.§ | | Sir A. Hunter. | |
| 10th Brigade. | 11th Brigade. | 5th Brigade. | 6th Brigade. |
| Coke. | Wynne. | Hart. | Barton. |

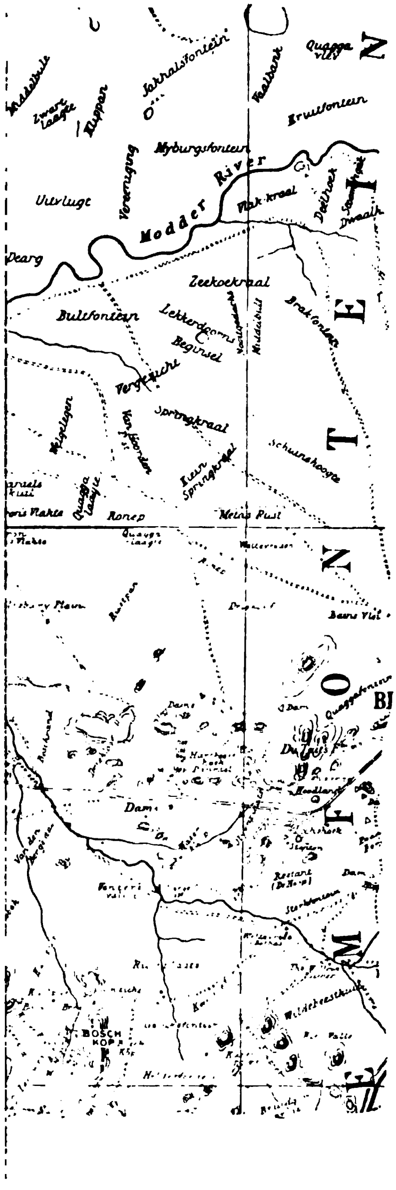
*Cavalry Division.*

| | | |
|---|---|---|
| 1st Brigade. | 2nd Brigade. | 3rd Brigade. |
| Burn-Murdock. | Brocklehurst. | Dundonald. |

* Pole-Carew was later transferred to the new 11th Division, Chermside receiving the 3d.

† Early in April Hart's Brigade was transferred to the western theatre to join Brabant. Barton's followed and was sent to Kimberley.

§ Relieved on account of his failure at Spion Kop, and sent to the western theatre or duty other than that at the front. Hildyard placed in command, May 1.



Modder River
Quagga Vlei
Jakhalsfontein
Vaalbank
Kruisfontein
Klippan
Myburgsfontein
Vereeniging
Uitvlugt
Vlakkraal
Zeekoekraal
Bultfontein
Middelbult
Brakfontein
Begin(s)el
Springkraal
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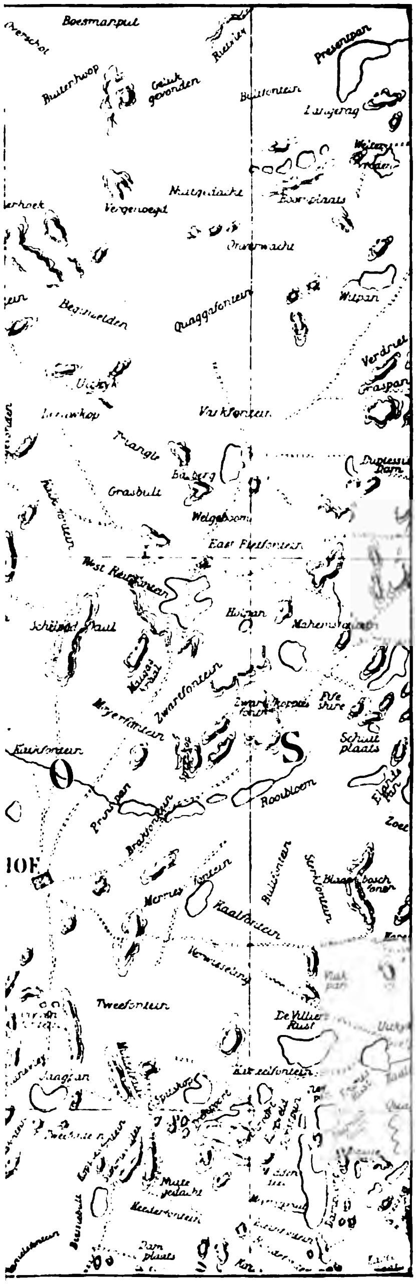
Boesmanput
Quaggafontein
Witpan
Graspan
Triangle
Grasbult
Zwartfontein
Rooibloem
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Kaalfontein
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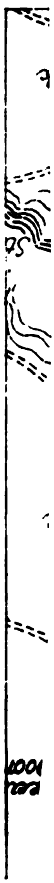

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**British Casualties of the War to April 7th.**

| | *Officers.* | *Men.* |
|---|---|---|
| Killed | 211 | 1,960 |
| Died of wounds | 48 | 465 |
| Died of disease | 47 | 1,485 |
| Died of accidents | 3 | 34 |
| Sent home as invalids* | 29 | 1,828 |
| Missing and prisoners | 168 | 3,722 |
| Wounded | 627 | 9,883 |
| | 1,133 | 19,377 |
| Total | 20,510 | |

**Total British Casualties to April 28.**

| | *Officers.* | *Men.* |
|---|---|---|
| Killed | 218 | 2,062 |
| Died of wounds | 53 | 492 |
| Died of disease | 64 | 2,028 |
| Died of accidents | .... | 48 |
| Sent home as invalids (not wounded) | 29 | 3,101 |
| Wounded | 764 | 9,225 |
| Missing and prisoners | 171 | 3,925 |
| Total (not including Invalids) | 22,180 | |

**Changes in Command.**

May 1st Hildyard received command of the 5th Division, *vice* Sir Charles Warren.

**British Casualties to May 19.**

| | *Officers.* | *Men.* |
|---|---|---|
| Killed | 224 | 2,131 |
| Died of wounds | 58 | 517 |
| Died of disease | 84 | 2,719 |
| Died of accidents | .... | 54 |
| Died in captivity | 1 | 49 |
| Sent home as invalids* | 525 | 9,893 |
| Wounded | 697 | 9,522 |
| Missing and prisoners | 171 | 4,304 |
| Total (not including invalids) | 20,680 | |

CAPTAIN JOHN P. WISSER, 7th Artillery.

(To be Concluded).

* Not including the wounded.

# A PROJECT FOR THE REGULATION OF SEA-COAST ARTILLERY FIRE, APPLICABLE TO THE RUSSIAN ARTILLERY.

*Reprinted from the Revue d' Artillerie.*

The Michel Artillery School of Russia offers an annual prize of five hundred roubles ($380) to the artillery officer submitting the best essay on a subject pertaining to the development of the artillery arm.

Captain De la Launitz was awarded the prize in the competition of 1898. The subject of his paper was: "A proposed method of regulating sea-coast artillery fire, employing devices and range finders already in service, with certain alterations."

The report of the committee of award appears in the *Artilleriskii Journal,* No. 4, of 1899. The object of this paper is to present a brief analysis of the report of this committee.

## GENERAL PRINCIPLES RELATIVE TO THE FIRE OF SEA-COAST ARTILLERY GUNS.

### *Preliminary Considerations.*

1. In the general case, the target will be in motion, and moving with a speed of from 8 to 10 knots per hour.
2. The combat will, ordinarily, be of short duration.
3. The targets, and the points of fall of the projectiles, will, as a rule, be distinctly visible.
4. The proper corrections must be made for the atmospheric conditions of the day, and for variations in the muzzle velocity.

### *Conditions to be observed in order to secure effective fire.*

(a) It is necessary to locate definitely the position of the target. (Consequently, artillery emplacements are furnished with special devices for measuring distances.)

(b) In determining the elements of fire, we must take into account the motion of the target during the "dead time,"—i.e., the interval elapsing between the determination of the range and the fall of the projectile.* This time should be reduced to a minimum by securing a rapid service of the guns, and by adopting the best type of range finder. The range finder should be, as far as practicable, entirely automatic in its action.

(c) On account of unavoidable dispersion, the fire should be concentrated, by firing in salvos of battery groups.

* In the French service, the "dead time" is usually understood to be the interval between the conclusion of the laying of the gun and the departure of the projectile.

*Principles of Organization.*

1. A sea-coast fortress should be divided into "sectors." Each sector should include a certain number of batteries forming a group, each group to have a separate commander.

2. Each group should have its own range finder, which automatically registers the corrections to be made due to the motion of the target. The central station of the group should be connected by telegraph or telephone with each battery of the group.

3. Each battery should be provided with some special device for transforming the "group" co-ordinates at the "central station," into those specially applicable to the battery. It is a matter of indifference whether this device be located near the "group" range finder, or in the proximity of the battery.

4. The battery commander should make the corrections for atmospheric conditions, and all the batteries of the "group" should be fired together at the command of the "group" commander.

Two methods are proposed for accomplishing these results.

(a) If it is considered desirable that the elements of fire be determined by automatic means alone, Lieutenant-Colonel de Charières's device, recently tested, promises excellent results.

(b) If we admit that certain corrections will have to be made by calculation, the scheme proposed by Captain de la Launitz will simplify many of the details of fire control.

Quite a number of other devices have been proposed. The "Rivals" method, tested at Gâvre, 1894-1896 deserves special mention.

*Explanation of the de la Launitz Method.*

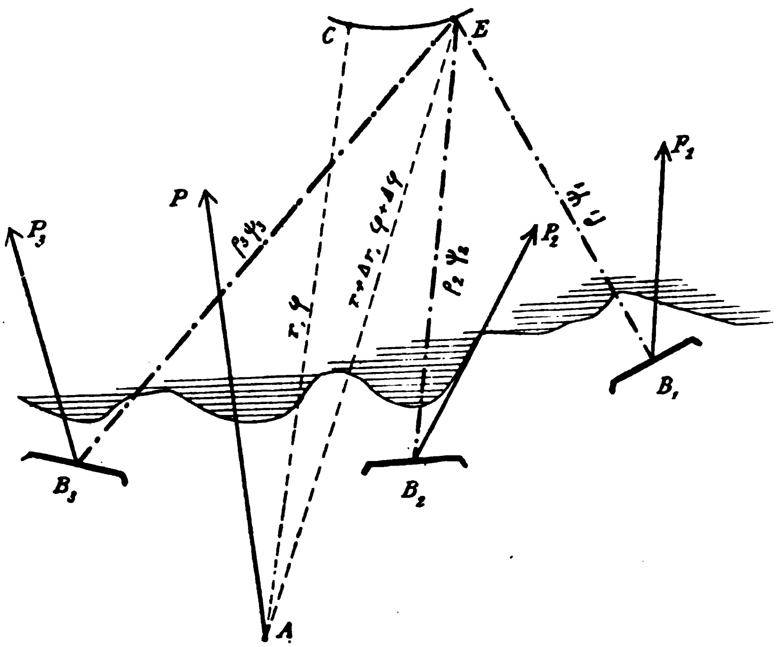
The "central station" of a "group," composed of the Batteries, $B_1$, $B_2$ and $B_3$ is located at the point "A." This should be an elevated point, and one that commands an uninterrupted view of the possible limits of fire of the group.

Each group is provided with a depression range finder. This instrument determines the polar co-ordinates of the target with reference to the polar axis AP.

Let r and $\varphi$ be the polar co-ordinates of C, the point sighted. The range finder gives directly the co-ordinates of the point E, ($r + \Delta r$, and $\varphi + \Delta\varphi$) where the target will probably be at the instant of the projectile's fall.

The data for the point E are telephoned to each battery, where the group co-ordinates are transformed into battery co-ordinates $\begin{pmatrix} P_1 & P_2 & P_3 \\ \psi_1 & \psi_2 & \psi_3 \end{pmatrix}$, referred to its own center and polar axis. The

polar axis of each battery passes through the central point of the battery front, and allowance is made for parallax. This correction is made by the means of a pivoted device (chvornevoi pribor) based on the principle of similar triangles.




Immediately after receiving the data trom the central station, each battery commander determines as rapidly as possible:

1. The corrections to be applied to the range, due to atmospheric and ballistic conditions. (These corrections are based upon actual trial shots at measured ranges).

2. The correction for drift, previously calculated for each range.

The battery commander then announces the angle of elevation, and the azimuth. (The gun is laid in azimuth by means of graduations on the traverse-circle.)

At the instant that the co-ordinates of the target are deter mined by the group range finder, the word "stop" is sent to each battery. The command "fire" is sent at the end of a fixed interval, counting from the instant of "stop".

The interval between "stop" and "fire," is determined by the group commander from drill experience. This interval includes the time devoted to sighting, the time required for the transmission of data, and for making the necessary calculations.

*Tests of the Proposed Method.*

As a result of the tests made at Sveaborg in 1895, the mean interval of time elapsing between the conclusion of the position finding determinations, and the end of the sighting was 99 seconds. (This interval is less than de la Launitz's "dead time" by the time of flight + "French dead time").

It follows, therefore, that a salvo can be delivered every two minutes. This rapidity of fire will be possible, for the time required to load the pieces in service is well within this limit.

At these same tests, arrangements were made for photographing the splashes. Making due allowance for the lack of training of the men detailed to serve the guns, the results were very satisfactory.

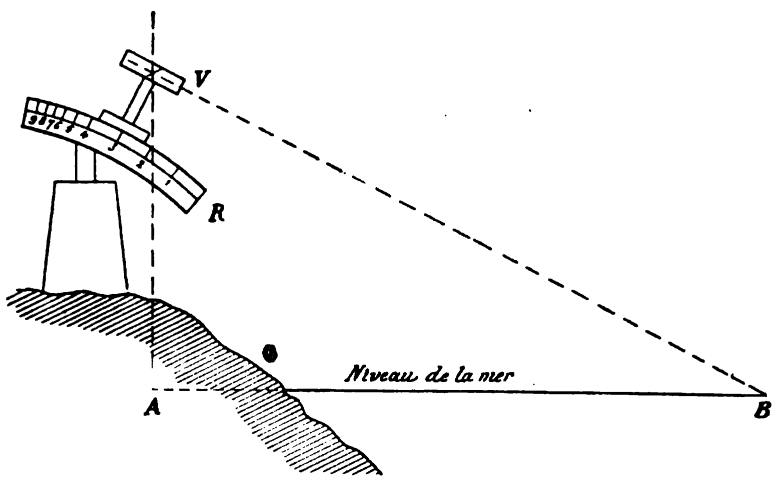
Further trials of this system were made in 1897 at Otchakov and at Sveaborg with excellent results.

*Notes on Instruments Employed.**

The relocating device for transforming co-ordinates was altered on certain lines suggested by Captain de la Launitz.

The range finders used in these tests were those actually employed in sea-coast batteries, viz., the Prichtchepenko, Model 1886, and the Menkess.

The principle of the Prichtchepenko position finder may be briefly summarized as follows :




A curvilinear scale of steel, R, is movable about a vertical axis. The telescope, V, sliding upon the scale R is employed

* Detailed descriptions of these instruments are not available.

for observing the movable target. An index attached to the instrument gives at once the horizontal distance AB in hundreds of sagènes. (A sagène is equivalent to 2.33 yards.)

The following are the modifications of this instrument:

A fixed graduated limb has been attached to the foot of the position-finder. In front of this fixed limb an index attached to the telescope moves. A special device has been added to the range indicator and the azimuth indicator, by means of which corrections may be made for the movement of the target.

An analogous modification for azimuth has been made in the Menkess range finder. In addition, the scale that indicates the ranges has been made movable, and furnished with a cam of such a shape that corrections for the movement of the target during the dead time are automatically made.

The Prichtchepenko position finder has also been improved. In lieu of a single scale of ranges corresponding to a mean base, a movable cylinder which is graduated to read ranges for varying altitudes has been substituted. In its latest form, this position finder automatically corrects for the curvature of the earth and atmospheric refraction.

The following table shows the results obtained in the autumn of 1896 with the old model of this range finder and those obtained with the later model:

| | | Old model. | New model. |
|---|---|---|---|
| Number of points on which sights were taken | | 4 | 5 |
| Topographical determination of distances | meters | 3780 | 2915 |
| | | 3770 | 3525 |
| | | 4150 | 3670 |
| | | 5280 | 5040 |
| Observations | Number of series | 101 | 166 |
| | Number of measurements | 404 | 830 |
| No. of errors in range determinations | positive | 109 | 374 |
| | none | 14 | 38 |
| | negative | 281 | 418 |
| Error in hundredths of distance | mean | 4 | 1.6 |
| | maxima | 16.5 | 5.6 |

For batteries near the water level, a depression range finder will be impracticable. However the same principles apply. For such batteries the Kholodovskii horizontal base position finder with certain modifications proposed by Captain de la Launitz to allow for the dead time is recommended.

It seems impossible, however, to remedy the inherent defect of all horizontal-base range finding systems, i.e., the practical difficulty of simultaneous sighting on the same point of the target. A series of special trials has recently been made at the shore batteries at Otchakov, and Sveaborg.

*Conclusions and Observations.*

The report of the commission was very favorable to the de la Launitz scheme. The conclusions may be summed up as follows:

1st. The method is perfectly adapted to the principle of fire control.

2d. The trials have shown that the method, in its "ensemble" as well in detail is simple, economical, and peculiarly applicable to sea-coast artillery fire.

3d. The precision of the method, and the resulting rapidity of fire meet all the demands of service.

4th. In brief, the scheme of Captain de la Launitz is peculiarly adapted to the needs and service of existing Russian artillery.

* * * * *

In concluding this analysis, attention is directed to the following points:

The method proposed differs decidedly from that in use in our service (the French).

The scheme presents certain analogies to the Audouard method of directing mortar fire.

In lieu of obtaining the range by "bracketing," the fire is to be by salvos of battery groups directed on the mean point.

The battery commander makes the initial corrections in range, which he deduces from preliminary trial shots made under known conditions.

Finally, this method, being an indirect one may be employed by batteries, entirely concealed from view.

M. C. Curey,
Lieutenant d'Artillerie.

(Translated by 1st Lieutenant Wilmot E. Ellis, 4th Artillery).

# THE DRAGON (OR KITE) BALLOON.

By A. von Parseval.

(Continued from Vol. XIII, No. 3, page 320.)

THE PRESERVATION OF THE EXTERNAL FORM.

In order, however, to produce the above advantageous actions, it is necessary, that the balloon should preserve accurately its external form.

For if any warping of the balloon or bulging in of the fore-plane arise, neither the kite plane nor the fore plane can execute the calculated action, since the irregular and strong pressure arising from the cavities catching the wind makes any calculation impossible. A perfect preservation of the outside form is therefore the condition for a favorable action of the machine. In order to prevent longitudinal curvings of the balloon, all the tendencies to greater and more permanent bending, arising especially from very faulty arrangements of the weights, must be carefully avoided.

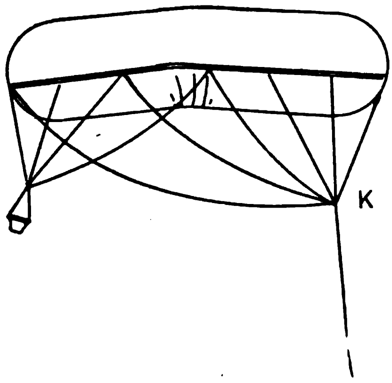



Fig. 4.

Figure 4 shows an incorrect cable suspension used by us in the beginning. At K the lines ran together in a knot, to which the cable was fastened. As a result, only once in a while, were all the lines perfectly tense. When this was the case the cable could be regarded as suspended at point K and drew down the front of the balloon too much by its weight. The result being that the basket had to be suspended very far back and so the gas in the middle pressed up and curved the balloon in the center, as the sketch shows, especially when the balloon moved in the wind.

Plate 1 shows the later anchoring. Basket and cable are so hung that perpendicularly over the suspension point a volume of gas is placed whose carrying power answers approximately to

the weight of the load. The gas on the left of the vertical A B carries the basket, the gas on the right of it, the cable. A perfectly accurate observance of this division of weight is, however, not at all necessary; the balloon can very well permanently resist smaller bending moments, and temporarily even the large ones. When a balloon body is bent as in Fig. 4 its volume grows considerably less, since the curved side becomes shortened and the area of the cross section in the bows of the balloon is sensibly increased. The covering must either be partially distended, or the balloon gas will be forced out of the balloon. But this requires work, which must be performed in the bending. Thus, the balloon offers resistance to the bending, and the higher the tension of the balloon gas, the greater the resistance. This can be readily estimated on a tightly inflated balloon. Let us consider two sections through the balloon which meeting at the point O (Fig. 5) make with each other an infinitessimally small angle, then we see that when the balloon bends these turn around O, and must approach each other, provided that the balloon bends so that the point O is pressed up, and the ends of the balloon down. But, the pressure in the cross section considered must be overcome. The resistance to bending in the cross section O is, therefore, equal to the moment of rotation of the pressure in the cross section O with reference to the bending axis passing through O.

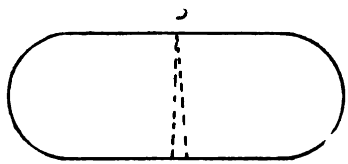


Fig. 5.

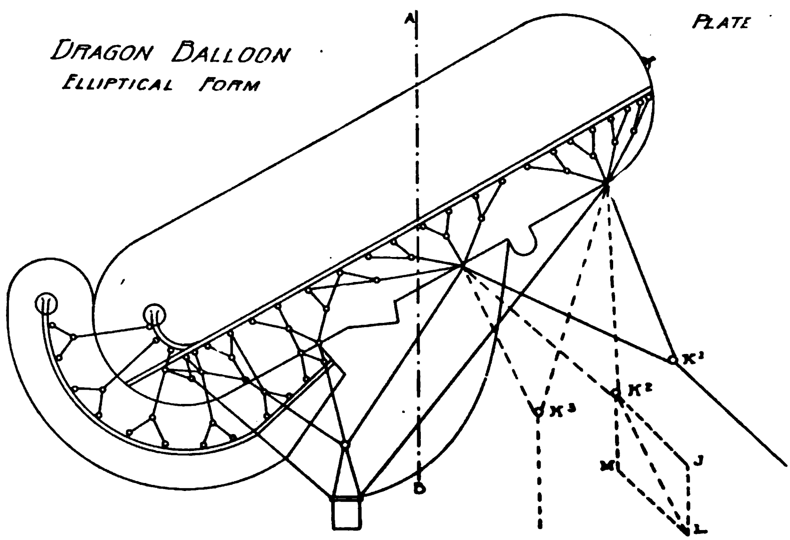
Suppose this pressure equal to the pressure of a column of water 1 mm. (.03 in.) high, giving to the balloon a diameter of 6 m. (6.5 yds.) then, imagine the pressure uniformly distributed over a cross section of 28 square m. (33.3 sq. yds.). The value of the turning moment would be 84 kg. (185 lbs.) at 1 m. (1.09 yds.) distant from the axis. Since the static pressures due to the vertical expansion of the balloon are several times greater than 1 mm. of water, the resistance to bending is greater; but it is diminished by this, viz.: that the material on the curved side of the balloon is distended. In consequence the bending axis is not at O but lower down in the section, taken across the balloon, and this causes a remarkable reduction in the resistance to bending. Our calculations are only of value for an absolutely inflexible balloon covering. We can, however, conclude from this, that small and medium bending moments, such as may be caused by the unavoidable irregularity in the adjustment

of the weight can be easily endured and the balloon not lose its shape.

Greater bending moments due to irregular movements, particularly by the sudden swerving of the balloon, produce only momentary and unimportant changes of form ; for by the resulting diminution of the volume the pressure in the balloon, and with it the resistance to bending, increases materially, because the gas can not escape quickly enough through the comparatively speaking narrow valve opening.

Experiments have shown that balloons tend to arch upward, to hump up their backs, so to speak.

Since, by such movements, the upper side of the balloon is subjected to considerably greater pulling force in the longitudinal direction, it has been strengthened by a strong draught arrangement running along the back. The stiffness of the balloon, would, however, hardly be sufficient in a strong wind if it were due to static pressure mainly. The static pressure, in itself, is not sufficient to prevent wind dents on the fore part of the balloon. For this reason the power of the wind is used to specially increase the inner pressure of the balloon. For this purpose a




large funnel-shaped wind sail standing perpendicularly to the wind is attached to the belly of the balloon, which conducts the air through a large opening into the inside of the balloon. The wind stows itself in the wind sail and produces a pressure which is carried into the interior of the balloon. This pressure is equal

to that made by the pressure of the wind on the head of the balloon. Since to this is added the static pressure produced in the interior of the balloon, which amounts normally to a head of water of 7–10 mm., any bagging of the front surface of the balloon is always prevented by the wind. If, however, the wind

PLATE III

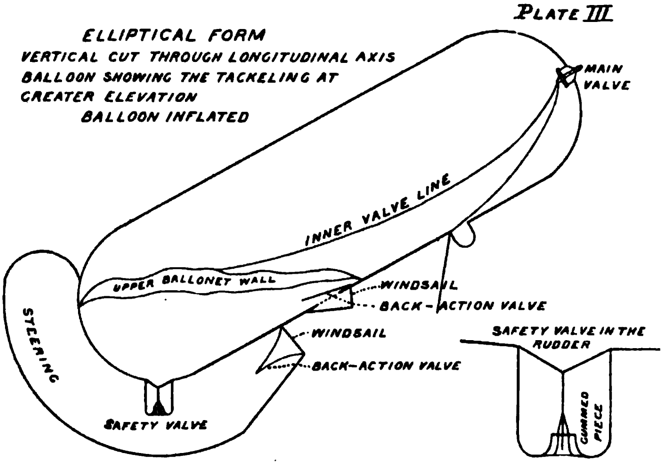
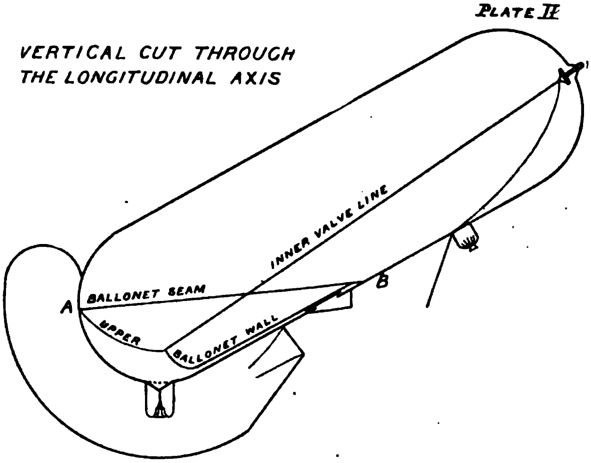



PLATE IV




poured directly into the gas-filled space, a heavy loss of gas and a more speedy waste of the balloon gases, would be unavoidable; the wind does not therefore blow into the balloon itself but into a spacious spreading ballonet. The air remains here, separated from the balloon gas by a light and compact folded wall of material which allows the transmission of the pressure, but prevents the mixing of the gases. In the adjustment of this ballonet the

fact was taken into consideration that two gases of different specific gravity, when uninfluenced, would place themselves one over the other so that the boundary between the two is make by a horizontal plane. In order, therefore, that the balloon may retain its form and the air may easily enter in, the ballonet must be attached to the deepest part and so formed that the material of the division plane can easily adjust itself.

To effect this, a horizontal section is laid through the balloon and the inner ballonet wall is sewed along this plane. (See Plate II).

Such a form is given to the latter that it almost entirely fills the space below the plane A B, making in a certain way, a second inner balloon space, leaving room for, however, a moderate play between it and the outside covering so that the air from the wind sail can easily reach the deepest part. Plate III shows the ballonet half filled with air. The balloon takes this form when it has lost gas; for example, when it descends from a great elevation and the previously expanded gas loses its volume again.

The ballonet can, in case of need, take in as much air again, the ballonet wall vaulting upward, in which case, of course, the separation plane is no longer level. In this form, with the present adjustment it is able to fill about ¼ of the balloon volume.

However, the experiments showed that this arrangement was not always sufficient. When in strong ascending movements of the air the rear part is elevated an unusual amount for a long time, it is possible, that by the static pressure of gas, combined with the continued and constantly changing irregularities of the wind, the ballonet is partially forced through the wide wind opening and folds or wrinkles are formed on the forepart of the balloon. The result is, that the gas reaches the rear part of the balloon and moves the point of application of the buoyant effort farther back, so that the recovery of the correct position is rendered more difficult. Under such conditions the balloon makes extremely dangerous movements.

Therefore the entrance-opening in the wind sail is closed by a flap of the material, which easily allows the entrance of the air—Plate III—but prevents its exit. This is made of a quadrangular piece of stuff which is attached with the front edge to the ballonet wall, but the other corners are held in the right position by cords of about 1 m. length. In order to let the flap open wide enough everytime, the inner ballonet wall must be narrower than the outer, so that there may remain between the two about the space of a hand's breadth when the balloon is entirely filled with

gas (Plate II). By this means the balloon is completely closed, and when it is well filled no bagging of any kind can arise through passing influences. A limited to and fro movement of the bulk of the air in the ballonet, in case of swerving movements, is always possible. Still, in the experiments, the whole adjustment has given satisfaction and maintained the form of the balloon unchanged.

The exit of the air out of the ballonet is regulated by a special safety-valve.

The adjustment of the ballonet with the wind sail is older than the dragon balloon; I had seen it (as well as the support girth) already on a round anchored balloon, constructed by von Siegsfeld for meteorological registrations. But it reached its present importance first as a means of maintaining the form of the dragon balloon.

The introduction of the flap of material belongs also to von Siegsfeld.

The natural inquiry arises: who is the real inventor of the dragon balloon? It may be briefly answered. The first idea, the initiative in the experiments, the arrangement of the drawing cords and the anchoring came from me. The farther development of the whole, especially of the rudder mechanism resulted from conferences between Herr von Siegsfeld and myself and from mutual suggestions.

The idea of the rudder-balloon belongs to Herr von Siegsfeld. For the rest, it can scarcely be determined from whom the first suggestions for the many details came.

### THE RUDDER MECHANISM.

The work on the dragon balloon was very materially aided by a means of help for which I had been searching from the first. Experiments could be made not only with balloons in the air, but with swimming bodies in flowing water, and the latter were far easier and simpler. Our clear and powerful mountain streams gave the most favorable opportunity for these, and a great many experiments were made without great cost or sacrifice of time, and every improvement, when possible, was tried first in the water before it was applied to the balloon.

A balloon of 60 cubic meters (212 cubic feet) capacity was first built for trial in the air. Later, a similar one of 600 cubic meters (21,190 cubic feet).

The first trial showed a very disagreeable peculiarity of the long balloon, vis. its propensity to side vacillations. Although the balloon was anchored far in front near the head, it did not

remain quiet in the line of the current, but made quick and violent side movements when tried both in the water and the air. Two different kinds of side vacillations could be recognized which were observed in manifold changes.

### SWERVING.

In this case the balloon deviates suddenly its head to one side. The angle of deviation may amount to 40 degrees. It does not stop here, however it turns instantly back to its equilibrium position, passes over it violently, just as far on the opposite side.

The movements in a strong wind are very violent and extremely unpleasant, particularly, when the basket begins to swing for-

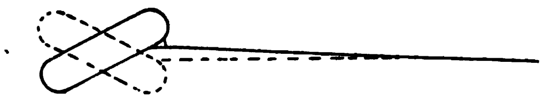


Fig. 6.

ward, and the support cords on one side of the balloon are one moment slack, the next stretched back with a sudden jerk. Thereby the balloon remains, as a whole, quietly in its place, but with its cable somewhat down-pressed.

### YAWING.

In this case the balloon turns with its head only a little to one side, does not turn back at once, however, but continues in this inclined position a long time.

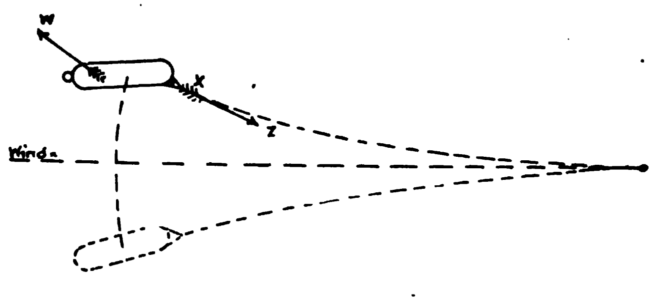



Fig. 7.

When the pressure of the wind strikes it on the flank, it commences to go sidewards, making at the same time exactly the movement of yawing, moving the length of the cable more or less; in some instances, many balloon lengths farther on. At last, the balloon comes to a stand still, takes the opposite inclination, turns back, and passes past its equilibrium position to the other side.

With a strong wind and short cable the balloon is often pressed sidewards down to the earth; with a long cable it makes the most dangerous movements, and, under some circumstances, may be turned over entirely. In this plight it is not serviceable, and the question at once arose how to give it a steering machine which should obviate these movements and allow of its being suspended in the wind without oscillation. Only when this was accomplished would the system be possible.

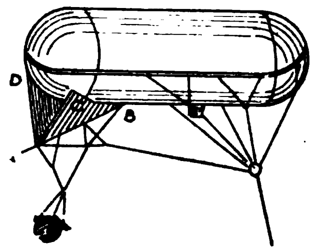



Fig. 8.

The whole aim of the experiments was now turned to the perfecting of the rudder.

The following sketches illustrate the principal steps in our experiments.

I. Illuminating gas balloon with rudder plane of 600 sq. m. area, made of two three-cornered sails A B C and A B D with a pole A B, the sail planes stretched by the hanging weight of the basket, the basket specially secured by cords at the corners of the balloon, which do not appear in the sketch (Fig. 8). The stability was sufficient in a moderate wind; but insufficient in a strong wind.

II. The rudder in Figure 8 was replaced by a balloon-like body, of conical form, inflated with air, closed behind by a hemispherical surface.

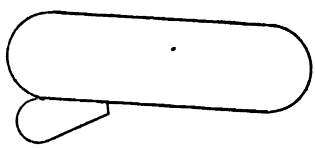


Fig 9.

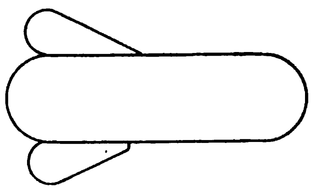


Fig. 10.

Steering not strong enough.

III. A second rudder body, similar to the first, is added to top of the 600 cubic meter balloon, and is inflated with gas. Fig. 10. The action was very satisfactory. In this form, the balloon was brought before the aeronaut division at Berlin. Its action was very satisfactory.

A smaller hydrogen balloon built afterwards and used in the maneuvers of 1894 at Elbing did not give the same favorable results. The rudder mechanism was therefore strengthened as indicated in Figure 11. and at the same time improved anchoring was used.

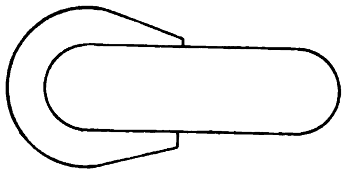


Fig. 11.

It was observed that the upper half of the rudder did not act advantageously and it was changed to the form in Plate I.

In the maneuvers of 1896 it was shown that the balloon could be kept elevated in a strong wind, but that the observations were still very much disturbed by the constant oscillations.

Only a little correction seemed necessary to obviate this oscillation. At the same time it was very doubtful whether it would be possible to attain this end by straightening the rudder made after the method so far followed.

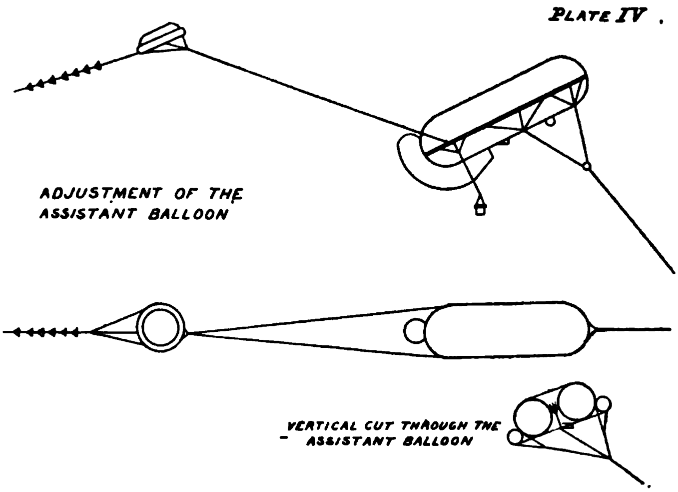
For, as soon as the limits of possible improvements were approached by enlarging the vertical rudder, the action of the latter begins to be affected by the unfavorable position of the center of gravity, and lastly, a vertical rudder is, by its nature, poorly qualified for obviating small oscillations, because its efficiency only begins when the balloon has already diverged to a certain extent from the equilibrium plane.

Therefore the aim was to apply a mechanism which should tacually subdue all side motions, that is, make them so slow that a perceptible delaying and hanging back of the basket could not take place.

This result (accomplished by Herr von Siegsfeld) is attained in the following manner: An assistant mechanism is applied to the balloon, which is drawn along by the movements with great atmospheric resistance. The best place for its suspension is on that part of the balloon which makes the greatest possible movements, and on the two lateral points lying far apart, so that the assistant organ is forced to join most completely in the side movements. It naturally appeared that smaller balloons could be used for this purpose. In order, however, to avoid the downward pressure of the principal balloon by the backward pull of an arrangement resembling a kite's tail, it was made like the dragon balloon.

Plate IV shows its form and adjustment.As its purpose is to exert force, aform was chosen which, with a small volume, would receive a high wind pressure. The principal body consists of a ring with a large central opening of about 10 c. m. (3.9 in.). A second ring is formed around this which lies upon the same surface foundation. The entire foundation is covered evenly with material and a wind sail applied to this covering which supplies

air to the space between the covering and the ring body, so that this acts like a ballonet and keeps the balloon in shape. An arrangement like a kite tail is added to the assistant organ to avoid unnecessary oscillations. The support cords are attached to the perimeter of the ring body ; a cord passes, besides from the anchoring point through the central opening, and conducts the force of the wind up against the middle part of the balloon. The diameter of the ring balloon amounts to about 70% of the diameter of the principal balloon ; the cable force to about 30%, the distance from the main balloon, 50 meters (54.4 yards).

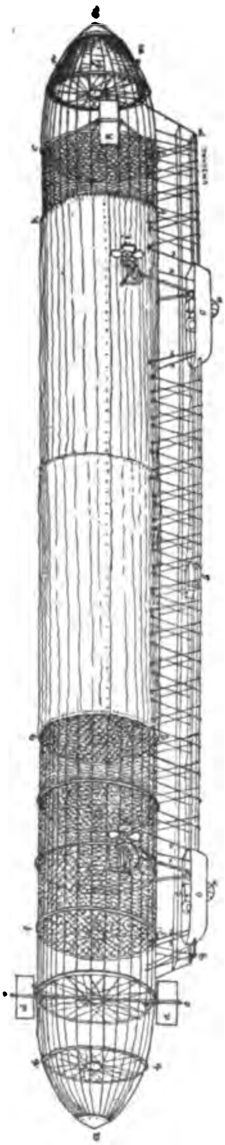



The suspension chosen is certainly not the most effective possible ; however, the working of this simple arrangement proved most satisfactory in the experiments, and the stability attained was perfect. In this way, the dragon balloon had two independent rudders each of which guaranteed the safe position of the balloon and the needed security against accidents. But, only the two combined give the stability demanded for observations. This also has the advantage that the rudders can not be entirely disabled by hostile fire. For, even if the assistant should be destroyed by a shot, the almost vertical rudder, quite insensible to separate shots, which always produce but a very small opening, would still remain intact.

DISTINCTIVE CHARACTERISTICS OF THE DRAGON BALLOON.

During the three years trials by the Prussian Aeronaut Division sufficient opportunity was given to become acquainted with

the peculiarities of the balloon in every way. This has been already referred to, still a brief resumé may be useful in coming to an intelligent conclusion.



V. ZEPPELIN BALLOON.

I. THE BEHAVIOR OF THE BALLOON IN THE AIR.

In a calm the balloon places itself motionless, with a pretty steep kite plane angle on the nearly vertical cable.

Rotations on account of the twist of the cable do not take place, because a sufficient current of air always prevails to keep the balloon suspended in a fixed direction.

In a wind, the balloon goes back in the direction of the wind until the cable takes an inclination of 30 degrees.

In changes, occasioned by sudden gusts of wind, or in rising currents of air, the balloon changes its place very slowly, almost imperceptibly for the inmates.

In a violent wind the position of the cable is somewhat more level.

Side oscillations are rare and feeble.

The dragon balloon is practicable on almost every day of the year, namely, when the wind allows the handling and inflation on the ground.

In the year 1895 it was kept up steadily at a higher elevation and with a wind, in which round balloons are entirely unserviceable.

A tolerably long cable (by overloading of the balloon) can be sent up in the wind by the kite action; however, with a less advantageous cable position.

The balloon can also ascend in the wind without danger, when the basket is overloaded.

When the wind abates, the balloon descends slowly and settles gently to the ground.

In case the cable breaks a free balloon results.

After a few oscillations the balloon takes a position somewhat steeper than when fastened to the cable. There is no particular danger attending it.

The duration of the practice of the dragon balloon is greater than that of the round balloon, an important consideration in

ROUND BALLOON IN THE FIELD.—*Armée et Marine.*

fortresses. The separation of the gases from the air by a wall of material makes the escape of the gases much slower; losses

of gas by violent motions and by wind pressure are avoided. Thus the gas is kept longer and besides a dragon balloon can be used with partially spoiled gas long after a round balloon would have been rendered unserviceable.

The whole buoyant effort can always be used in the dragon balloon—in the round balloon only a part of it—at least as soon as there is little wind, because the round balloon is held up only by its buoyancy, while the dragon balloon is borne up by the wind itself.

One disadvantage of the dragon balloon is the greater weight of material. In a calm the round balloon reaches a greater height. On that account, it has been proposed to use both kinds. But whether one will not be limited in the field to the absolutely necessary, practice alone can determine.

### 2. THE HANDLING OF THE BALLOON.

This offers no particular difficulties. The laying out and inflation take the same time as in the round balloon.

The transportation is easier if the balloon is placed so that the head is toward the wind.

The pull on the cable is smaller.

The balloon can be inflated and managed in a much stronger wind than the round balloon, because it does not stand so high above the ground and because in case of necessity many more people can be employed.

The balloon can be more easily concealed and anchored behind cover.

### CONCLUSION.

We have reached the end.

It was impossible in our limited space to follow in detail all the changes in the history of this invention. To show in what manner, step by step, the new forms were developed. Many fruitless trials, many changes later abandoned must remain unnoticed; in particular, the contrivances for the artificial reinforcement of the wind pressure which really consisted of a combination of a wind wheel with a ventilator. The undertaking was attended with many anxieties and many deceptions before the balloon was perfected for military purposes.

Thanks are due from the inventor to his assistants, in the first place to Herr August Riedinger in whose workshop the balloon was begun. This workshop originally established for the building of a flying machine, under the direction of Herr von Siegsfeld, gave the opportunity for the first groping experiments,

from which the correct principles by degrees were developed, and although later, the work on the flying machine was given up, the origin of the dragon balloon still remains, a lasting memorial, it is to be hoped, of that activity.

The distinguished services rendered by Herr von Siegsfeld deserves farther mention. An important part in the perfecting of the rudder mechanism and of the valve arrangements is due to him, but especially the introduction of the balloon in the aeronaut division, as well as the solving of many practical details, not less important than the solution of the main problem.

In conclusion, I desire to give deserved thanks to the Royal Prussian Aeronaut Division, and to its highly honored commander Major Nieber for their energetic and successful aid.

During three years the Royal Prussian Aeronaut Division has shared in the experiments with their personnel and their material resources, and these experiments have been by no means an uninterrupted series of successes.

Only one who has experienced the disheartening sensation of the total failure of a great balloon experiment can rightly value this continuous support.

There is no doubt but that the evolution would have demanded a much longer time without the aid and support given by Major Nieber.

First of all, the dragon balloon is of course serviceable for military purposes, perhaps meteorology will also in time make use of it to keep observation instruments continually elevated. May it then fulfill the hopes placed in it and do its duty in storm and all kinds of weather, in the service of science, and on the battle-field, to the glory of the aeronaut, the honor and welfare of Germany.

Augsburg, September 1896.

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Augsburg, May 9, 1899.

The Chief Signal Officer,

Washington.

The discontinuance of the Parseval-Siegsfeld patent of my dragon balloon, now adopted, after several years trials and experiments, in the aeronaut corps of the German army, and introduced by a decree of the war office in Austria and other states, permits me to call your attention to this recently tested war material.

The peculiar characteristics of the dragon balloon are that it

is able to stand firm in the wind like a kite and to ascend in a calm like a round balloon.

Statistics prove that on an average the dragon balloon can be used 70 days out of 100 while the round balloon can only be used 30 days out of 100.

In consequence of the oblong form of the dragon balloon and its small diameter it can be sent up behind cover and in a limited ground.

The unpacking, filling with compressed gasses and sending up of the balloon requires about thirty minutes, after which, information already prepared can be sent down from the basket of the balloon.

The capacity of the balloon is 600 cubic meters (21,190 yds.) carrying two observers up 600 meters (654 yds.) or one observer 1,000 meters (1,090 yards).

Occasionally during practice on board of a torpedo boat that bears against the wind, the velocity of the wind amounts to 20 to 30 meters (21.8 to 32.7 yards) per second, and the capability of management of the balloon at sea is thereby demonstrated.

25 meters (27.3 yards) per second for the velocity of the wind is the extreme limit permitted for the balloon's usefulness. When one considers that a useful observation is guaranteed the round balloon with the wind velocity only up to 8 meters (8.7 yards) the superiority of the dragon balloon is clearly shown.

Without the disturbing influences of dust and fog formations on land which make observations from the basket of the balloon difficult, the air at sea is generally purer and clearer so that with strong glasses large boats can be distinctly observed 100 kilometers (62 miles) distant.

Employed in small dimensions the dragon balloon is especially adapted to carrying up the wires for the Marconi-telegraph apparatus and understandings can be obtained at distances which exceed substantially the visual distance hitherto made.

The use of the dragon balloon for coast defenses will in the future be largely increased.

The experiments which were made in Germany and in Austria-Hugary in 1897 and 1898 at the great Imperial maneuvers are especially determinative for the introduction of this balloon.

As a result of these trials the round balloon is no longer employed for the field divisions of the German army.

The party in war which must leave such an observatory to the opponent alone is decidedly at a disadvantage for in modern wars where smokeless powder and the great range of the weapons

make observation very difficult the commander in chief will not willingly wish to resign such a superior means of observation.

It should be observed here that the dragon balloon is clearly the one to stand quiet in the wind allowing binocles and telescopes to be turned about from the basket of the balloon while it is forced through sail and tail.

The round balloon on the contrary rocks up and down and rotates continually. How can a reliable observation be taken ?

It is a well known fact on the other hand that the effect of a strong wind on a kite is merely to make it ascend more.

The best solution of the anchored-balloon is the union of the balloon with the kite and this gives the dragon balloon.

* * * * *

A. Riedinger.

# THE DEVELOPMENT OF THE KRUPP FIELD ARTILLERY MATERIAL.*

1897.

(Translated from the German by M. WILLIAMS, and arranged for publication in the office of the Chief of Ordnance.)

## NOTES ON THE CONSTRUCTION OF ORDNANCE.

Washington, April 13, 1900.

### I.

### PREFACE.

The last report from the proving ground, published in October, 1892, by the firm of Fried. Krupp, covered the tests made in 1891–92 with rapid-fire field guns of 6-cm. (2.36-inch) bore. These guns belong to the class of field guns with fixed ammunition, of 6 to 8.7 cm. (2.36 to 3.42-inch) caliber, as they were then manufactured by Krupp, forming a separate group, being strictly rapid-fire or rapid-loading guns. Whereas guns of 7 to 8-7 cm. (2.76 to 3.42-inch) caliber differ chiefly from earlier field guns in greater ballistic power and readiness of fire, which is attained by the use of smokeless powder in connection with fixed ammunition; in the case of 6-cm. (2.36-inch) guns, part of the ballistic power has been sacrificed to greater rapidity of fire, to attain which the gun carriage is provided with a special brake to diminish the recoil and a contrivance for rapid traverse. Also metallic powder case and projectile are combined in one cartridge. The good results of these proving-ground tests excited comment everywhere and have been discussed in detail in technical literature. One result of these discussions is, that this proving-ground report, together with several which appeared shortly before, were most serviceable in bringing into greater notice the peculiarities and results of rapid-fire guns of smaller caliber. It was necessary for the gun factory to begin the construction of rapid-fire field guns with those of smaller caliber, without intending to stop there. As all the literature on the subject at that time seemed silently to combine the idea of rapid-fire guns and small caliber—that is to say, the greatest stress was laid upon the velocity to be attained at close and medium ranges, and upon the greatest possible number of projectiles to be carried, the report was much misunderstood and interpreted as if Krupp's

* Reprinted by permission of the Chief of Ordnance, U. S. Army, who also very kindly loaned us most of the plates.—ED.

factory meant only these cannon of small caliber, when referring to rapid-fire field guns. A further reason for this misconception was the fact that the results of the tests of the 8-cm. guns were adduced for comparison. A fair comparison could not result from the figures in question, because the absolutely essential grounds for any comparison were wanting; the 6-cm. (2.36-inch) and 8-cm. (3.15-inch) guns were in no wise similarly constructed. However, those 6-cm. (2.36-inch) guns were the type of light rapid-fire guns which were to make up for the lack of of single-fire effectiveness by increased rapidity of fire and the consequently attainable volume of fire. Opposed to these on the other hand, and as types of the greatest effectiveness of single-fire guns, were the 8-cm. (3.15-inch) rapid-loading cannon L.29 and L.30, with a projectile weighing from 7 to 7.5 kg. (15.4 to 16.5 pounds) and a muzzle velocity of 570 and 550 m. (1,870 and 1,805 feet per second). The leading ideas in their construction were most advantageous use of material and greatest effectiveness of the single shot, with sufficient mobility. The weight of the gun was 450 kg. (990 pounds), the weight of the carriage, 550 to 610 kg. (1,210 to 1,340 pounds), so that the weight of the complete system was from 1,000 to 1,060 kg. (2,200 to 2,330 pounds). With the lightest of these guns, at the trial in 1890, the muzzle velocity of the 7-kg. (15.4-pound) projectile was increased to 597 m. (1,960 feet per second) without detriment to the durability of the piece and with even partially diminished recoil; the greatest effectiveness ever reached with a field gun, corresponding to a muzzle energy of 127 mt. (410 foot-tons).

Because of various considerations this achievement and the claims made for the gun were lowered, as both offered serious drawbacks for field service. The velocity was again reduced to 570 m. (1,870 feet per second), and in order to obtain more steady working of the gun, the weight of the carriage was increased to 600 kg. (1,320 pounds).

It required time and numerous experiments to obtain a suitable compromise in authoritative artillery circles between the two efforts described; a compromise between effect and mobility, single fire and volume of fire. The Krupp factory was at that time of the opinion that rapid fire was not the chief object of the co-called rapid-fire guns, but that only through the latter could simplification of manipulation of the whole of the various parts be reached. This simplification appears under certain conditions in the increased rapidity of fire. However, even then, the Krupp factory had no doubt that the effect of single fire and mobility

should not be decreased in favor of the new systems. From the following representations it will be seen what ideas and experiments led to the constructions produced from that time, 1890–1892, till 1897, inclusive; what methods were successful and what not suitable.

The attained simplification of the gun and its manipulation concerns:

1. The fermeture, the gas check for which is replaced by a metallic case, acting as gas check itself, containing the primer and the charge, and which is renewed for every round.

2. The carriage, the recoil of which is diminished, together with means provided for rapid traverse.

3. The ammunition, inasmuch as the separate primer is done away with, and combined with the cartridge, fixed ammunition being used.

These simplifications could produce a considerable increase in the rapidity of fire only when smokeless powder was used. Consequently the use of smokeless powder is closely allied with the development of rapid-fire guns.

## GUNS.

### MATERIAL AND CONSTRUCTION.

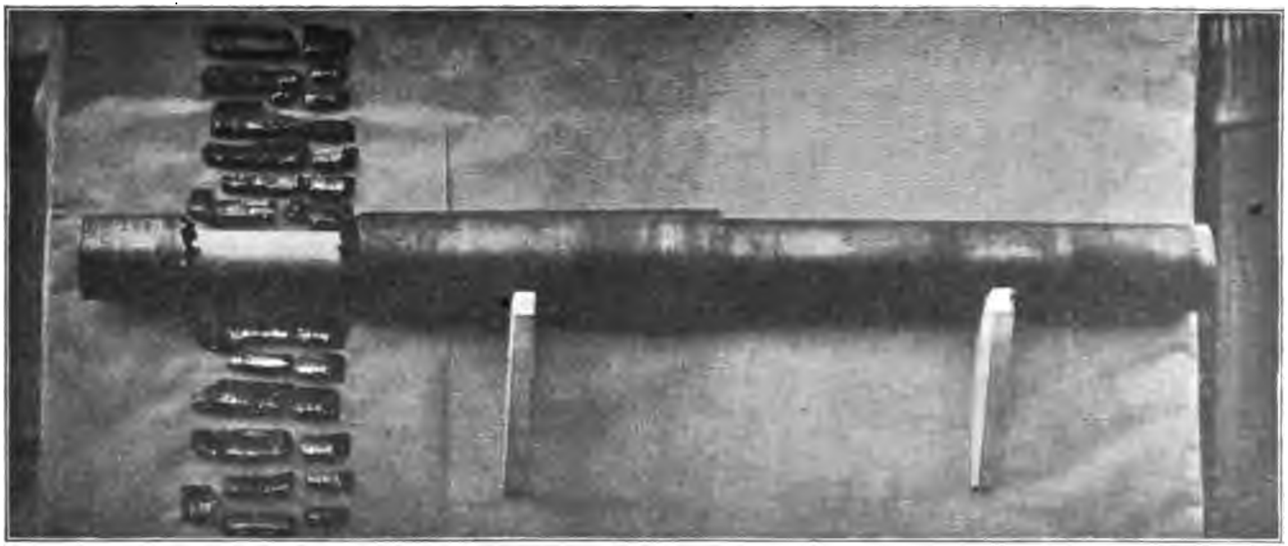
The Krupp rapid-fire field guns are all constructed upon the jacketed-tube system. The material is crucible steel. Steel alloys of greater toughness are employed where the use of high explosives for a bursting charge is intended. Whereas with ordinary gun metal, in case of a detonating high explosive shell, the barrel is shattered when the explosion takes place and the fragments become dangerous to surroundings, with the use of Krupp's new steel alloys and with proper calculation of the charge and of the high explosive, only a swelling, corresponding to the strength of the explosive charge, with eventual cracks, appears. Plate I shows behavior of both kinds of metal.

The condition that to insure against bursting, the high-explosive projectile must not exceed a certain weight, is self-evident, because the field gun is also confined within a certain limit of weight. The use of the method of wire construction, as illustrated by the English 7.6-cm. (3-inch) field gun of the mounted artillery, would not affect this point.

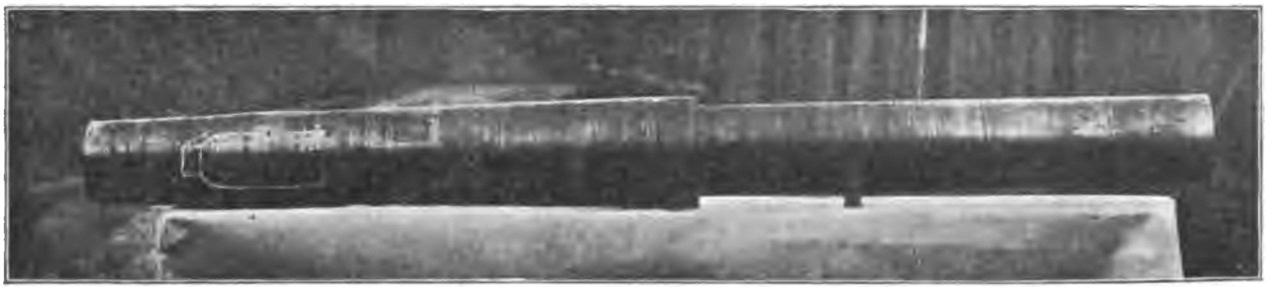
Some of the most important gun constructions are noted in Table I. From this table it will be seen that the Krupp factory shows preference for a field gun of a length of 26 to 30 calibers, but the whole length of the gun must not exceed 2.25 m. (88.6 inches) on account of transportation.

PLATE I.

Effect of bursting a steel shell in the tube near the muzzle. Weight of projectile, 15.43 pounds; bursting charge, 0.475 pounds picrid acid.



A.—Tube for 3.307-inch field gun, old kind of steel.



B.—Tube for 3.307-inch field gun, new steel alloy.

TABLE I.—RAPID-FIRE FIELD GUNS.

| No. | Caliber. | Total length of gun. | | Travel of shot. | Weight of gun with fermeture. | Ballistic conditions. | | | Energy per pound of gun. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Weight of projectile | Muzzle velocity. | Muzzle energy. | |
| | *inches.* | *caliber.* | *inches.* | *inches.* | *pounds.* | *pounds.* | *ft. sec.* | *foot-tons.* | *ft.-lbs.* |
| 1 | 2.561 | 31 | 78.74 | 66.1 | 606.4 | 9.48 | 1,574 | 162.1 | 610 |
| 2 | 2.758 | 26 | 70.86 | 57.4 | 584.3 | 11.00 | 1,443 | 159.2 | 610 |
| 3 | 2.758 | 28 | 75.59 | 62.2 | 595.4 | 11.00 | 1,476 | 166.3 | 623 |
| 4 | 2.955 | 24 | 70.86 | 58.5 | 606.4 | 11.00 | 1,476 | 166.3 | 617 |
| 5 | 2.955 | 28 | 82.67 | 65.1 | 771.8 | 13.20 | 1,640 | 246.7 | 715 |
| 6 | 2.955 | 30 | 88.58 | 70.5 | 782.8 | 14.00 | 1,591 | 245.4 | 702 |
| 7 | 2.955 | 30 | 88.58 | 70.5 | 837.9 | 13.89 | 1,640 | 258.3 | 682 |
| 8 | 2.955 | 28 | 82.67 | 65.1 | 882.0 | 14.30 | 1,640 | 267.4 | 679 |
| 9 | 2.994 | 29 | 87.0 | 63.8 | 882.0 | 14.00 | 1,804 | 316.1 | 804 |
| 10 | 3.075 | 28 | 86.22 | 65.4 | 882.0 | 14.30 | 1,804 | 323.5 | 822 |

These guns fire charges the total weight of which varies from 4.3 to 6.5 kg. (9.45 to 14.3 pounds) and have a caliber of 6.5 to 7.8 cm. (2.56 to 3.07 inches). Most of them are of 7.5 cm. (2.95 inches), as this caliber, in connection with a weight of projectile of 6 kg. (13.2 pounds) and a muzzle velocity of 500 m. (1,640 feet per second) accords with weight of gun suitable for European conditions. For special use, chiefly outside of Europe, the caliber, weight of charge, and muzzle velocity (and under certain conditions only the latter) will not reach the figures of 7.5 cm. (2.95 inches), 6 kg. (13.2 pounds), 500 m. (1,640 feet per second), respectively ; the table shows several such successfully attempted pieces.

The effectiveness of the piece (see last column, Table I) is closely connected with the result to be obtained from the whole system.

### FERMETURE.

For a fermeture the Krupp factory uses chiefly the horizontal quick-loading wedge mechanism, made and patented by the firm. It usually opens to the right, and for greater convenience in loading, the breech of the piece is cut away on the left side up to the wedge aperture (Plate II). This wedge mechanism is constructed in several forms to suit the special wishes of the purchaser. Besides these, the factory also makes numerous designs for vertical wedge mechanisms and for screw fermetures.

In all rapid-fire field guns, the fact should not be lost sight of that the fermeture is only a part and not even the most important part of the system. A large number of fermeture designs fulfill the conditions of perfect working under all circumstances,

and most of them in regard to rapidity of loading are endowed with superfluous capacity of achievement.

For instance, in the case of a 7.5-cm. (2.95-inch) cannon with immovable carriage and Krupp's wedge mechanism of the same pattern as that used for field guns, as many as forty rounds a minute have been fired, a number not to be considered for field-artillery purposes.

The details and peculiarities of fermetures are not to be further considered here, as it is intended later to make them the subject of a special report.

### SIGHTS.

The position of the line of sight must be determined chiefly by the fermeture pattern used, so that the gunner shall not be inconvenienced by the cannoneer serving the fermeture. In handling the gun, the work should be subdivided as much as possible, so that one man attends to the sighting only, one man to the fermeture, and one man solely to the loading; these three men should work well together.

These demands are easily fulfilled with the wedge fermeture. With screw fermeture the special conditions of construction require moving the sight forward to make room for the corresponding parts of the fermeture and its manipulation and also in order to leave the breech free for the other service. This arrangement has the disadvantage that special lugs for the sights must be secured to the gun, which reduces the assurance of the position of the line of sight being invariable. Moving the line of sight forward has the further drawbacks that the axle seat on the same side of the gun interferes wifh the pointing, that the attachment of the wheel brake meets with difficulties, and that the gunners standing on the same side of the carriage interfere with each other. In the case of guns with wedge fermeture, the face of the breech is the proper place to attach the rear sight and the front sight should be secured to the trunnion band.

The importance of taking quick aim with rapid-fire guns is allowed for in Krupp's guns by setting the rear sight obliquely to correspond with the lateral drift of the projectile, so that under normal conditions the drift takes care of itself. and, furthermore, by the fact that the rear-sight bracket is provided with a worm gearing that can be thrown out of action. In this way the elevation can always be easily and very exactly fixed.

## CARRIAGES.

### GENERAL OBSERVATIONS.

The most difficult problem to solve in connection with rapid-

fire guns is the construction of a proper carriage. With small caliber, small weight of charge, and small general effectiveness, it was possible, with the use of the new ammunition, to attain, even with a movable carriage, rapidity of fire which considerably surpassed that of ordinary field guns.

It was not difficult to construct for such guns of small caliber a carriage without recoil, or with much diminished recoil, because the proportion between weight of ammunition and muzzle velocity on the one hand and the weight of gun on the other, resulted in a reduced recoil without great demands being made on the carriage as regards its power of resistance or its means of checking recoil. When convinced of the impossibility of obtaining by this method a rapid-fire field gun satisfactory also for single fire, the difficulties of constructing a suitable carriage appeared so much the greater the more it was attempted to increase the effectiveness of the single round in connection with rapid fire without overstepping the weight limit prescribed for field guns.

Added to this, the carriage must be not merely a firing platform, but also part of a good vehicle, in order that the gun may under all circumstances be turned on the enemy quickly, ready to fire. The demands on the carriage as a vehicle, at least in time of peace, are greater than for firing purposes.

Owing to the demand for increased readiness of fire and the consequent necessary changes in the carriage, the difficulty of making it a good vehicle is much increased, and the old trouble—the conflict between mobility and effectiveness—exists to-day to a notably increased degree. To reach the goal two methods must serve, viz., the use of the best and most suitable materials for the different parts, and the best arrangement thereof for the object in view.

Krupp's factory has always laid great stress on the first point with the older models of carriages. With the suddenly increased requirements brought about by the construction of a rapid-fire carriage, the old material was no longer suitable.

Recognizing this the Krupp factory, by a large number of trials, determined the most suitable material for all important parts, always using the newest improvements in the production of steel, and putting the question of cost of material in the background. It was thus possible to increase the durability of the carriage while lessening its weight.

In the construction thereof the following points claim chief attention:

## CONTROL OF RECOIL.

For the simplification of the manipulation and increase of effectiveness of fire, the greatest diminution of recoil is the most important factor.

With an ordinary field gun, between rounds, the greatest time is required to bring the gun back to firing position from the recoil. The task was, therefore, to shorten the recoil of the rapid-fire gun as much as possible, to keep the gun in firing position, or to bring it back into position automatically.

The construction made before and after progressed in these three directions. It was first attempted by using a heavier brake on the wheels, that is, a better application of the friction of the recoil of the carriage on the ground. Then the carriage was given a point of resistance in the earth, by means of the trail spades and spurs. At last the connecting point between the carriage and the ground was made elastic and movable. At the same time efforts were made to reduce the strain through the introduction of hydraulic brakes, either between the gun and the carriage or between the carriage and the trail spade.

TABLE II.—COEFFICIENT OF FRICTION FOR FIELD CARRIAGES.
*Obtained experimentally (in firing).*

| No. | Piece. | Weight of piece and carriage. | Ground. | Brake on or off. | Coefficient of friction. | |
|---|---|---|---|---|---|---|
| | | | | | Brake on. | Brake off. |
| | *inches.* | *pounds.* | | | | |
| 1 | 2.24 | 1,477 | Level meadow land | On | 0.586 to 0.640 | |
| 2 | 2.24 | 1,477 | Level meadow land | Off | ..................... | 0.167 to 0.175 |
| 3 | 3.15 | 2,216 | Level meadow land | On | 0.582 to 0.626 | |
| 4 | 3.15 | 2,216 | Level meadow land | Off | ..................... | 0.151 to 0.156 |
| 5 | ......... | ......... | ............................ | Mean | 0.608 | 0.162 |

## WHEEL BRAKES.

The utmost a brake can do is to hold the wheel immovable and so transform the rolling into sliding friction. The difference between these two methods of motion in regard to friction is shown in Table II, which is the result of practical experiments. According to this the coefficient of friction on horizontal, natural ground amounts to about 0.16 on a gun without brake, and to about 0.6 with brake. Naturally, these figures are only correct on special ground, and with a special distribution of weight on the wheels on the one hand and on the trail spade on the other; under other conditions they would be altered considerably. Anyway, this demonstrates that, as the length of the recoil is in inverse ratio to the coefficient of friction, a diminution of recoil

in the proportion of 60 to 16 or 15 to 4 is attainable. The recoil of a gun with brake would always amount to more than one-quarter of that of a gun without brake, even if during fire the wheel pressure and the trail pressure maintained the same proportion as when at rest. But as the wheels rise somewhat during fire, or the whole gun springs from the ground and jumps backward, it is really possible for the brake to reduce the recoil about one-third only. For recoil measurements of guns with and without brakes refer to figures given in Table III, on page 335.

The Krupp factory models of axle-brakes as well as wheel-brakes are made either to act during fire and be released thereafter or else self-acting, so that the brake acts with increasing strength during fire and lets go of itself when the gun is brought back to place. Counter recoil, which would obviate subsequent bringing forward of the gun, can not be achieved with wheel-brakes alone. Although from the nature of the arrest of the motion, as well as because of the long recoil, the wheel-brake does not cause an extra jump of the gun, still the gun frequently swerves from the direction, owing to the usually unequal constraint of the two wheels. Wheel-brakes are, therefore, in this connection unfavorable for rapid-fire. They have not justified themselves, while the brake-block has developed into a grooved wheel-ramp, on which the gun moves during part of the recoil. The Krupp factory possesses such a model in the "firing and driving brake for carriage wheels," patented December 25, 1892.

RIGID SPURS.

Another means of reducing the recoil is the long-known appliance of a rigid spur on the trail; in the case of guns of minor effectiveness as. for instance, the 6 cm. (2.36-inch) guns, a simple spur of this sort has proved successful. In cases of greater ballistic effectiveness, on hard soil, therefore with less recoil, the rigid spur causes a more or less extensive jump of the gun, whereas on soft soil it produces a burying of the trail. If the axis of the piece is oblique to the plane of symmetry of the carriage, or, if the ground resistance varies at different points of the spur, the gun has a tendency to turn horizontally around the trail and so to change the direction. The change will increase with the length of time the wheels turn in the air—that is, the higher the carriage jumps. Naturally this reduces the rapidity of fire.

These drawbacks to the rigid spur gave rise to the idea of using it only in special cases when the soil and general character of the ground favor its application, and caused the construction

TABLE III.—DETERMINATION OF PRESSURES OF TRAIL ON GROUND AND RECOIL.

| No. | I | II | III | IV | V | VI | VI | VIII | IX | X | XI | XII | XIII | XIV | XV | XVI | XVII | XVIII | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Weight. | | | | | | | | | Pressure of trail on ground. Brake off. | | | Recoil upon pretty hard ground. | | | | | |
| | | | | | | | | | | | | In firing. | | Brake off. | | Brake on. | | | |
| | Piece. | Gun. | Gun mounted. | Projectile. | Charge. | Initial velocity. | Maximum pressure. | Elevation. | Angle of trail. | Recoil of piece in caliber. | At rest. | Without recoil of piece. | With recoil of piece. | Without recoil of piece. | With recoil of piece. | Without recoil of piece. | With recoil of piece. | Remarks. | |
| | | *Lbs.* | *Lbs.* | *Lbs.* | *Lbs.* | *Ft.* | *Atm.* | *Deg.* | *Deg.* | | *Lbs.* | *Lbs.* | *Lbs.* | *Ft. In.* | *Ft. In.* | *Ft. In.* | *Ft. In.* | | |
| 1 | 2.244-inch gun on mountain carriage. | 229 | 573 | 5.9976 | .3696 | 1,312 | 1,850 | 0 | 30 | 2 | 99 | 16,096 | 13,560 | 20 0 | 19 4 | . . . | . . . | Trail pressures with braked carriages were not measured. | The comparison of the measurements of recoil is not absolutely correct, as they were not all made on the same grounds, and they are only the result of single rounds. The carriages had no device for control of recoil save the carriage brake, which served also as a firing brake; neither had they any sighting device. |
| 2a | 3.15-inch gun on field carriage. | 992 | 2,260 | 15.4 | 1.87 | 1,870 | 2,200 | 0 | 36 | . . | 271 | 31,075 | . . . . | 21 0 | . . . | 6 7 | . . . | | |
| 2b | | | | | | | | 10 | | | | 31,075 | . . . . | 19 4 | . . | 5 11 | . . . | | |
| 3a | 3.15-inch gun on field carriage. | 992 | 2,370 | 15.4 | 1.87 | 1,870 | 2,200 | 0 | 33 | 1½ | 276 | . . . | 15,082 | . . . | 19 4 | . . . | 7 3 | With braked carriages the trail pressure was increased about 1,102.5 pounds. | |
| 3b | | | | | | | | 10 | | | | . . . | 16,317 | . . . | 16 4 | . . . | 6 3 | | |

of the folding spur. A carriage provided with a rigid folding spur is shown on Plate III.

The more universal use of the rigid spur in cases of increased ballistic effectiveness has been prevented by considerations of durability of the carriage, because with the strong recoil of the gun and the great resistance of the spur on the end of the trail this method of control entails danger of breaking the main carriage parts, especially the flasks.

RECOIL OF GUN.

To decrease this danger the Krupp factory, as far back as 1856, introduced an elastic connection of the gun with the carriage by placing rubber buffers between the trunnions and their beds and the aiming gear and its supports. A printed report of tests made in January, 1857, by Prussian, Hanoverian, and Brunswick officers of artillery with a 12-pounder Hanoverian gun attached in this way to the carriage mentions good results. Why the Krupp factory did not follow up this construction can not now be determined, but that it was used and further developed elsewhere is known; it is only necessary to recall the Engelhart construction. A hydraulic brake between the gun and carriage was also proposed in order to reduce the wear and tear of the carriage. By this means the carriage was protected, but if the extra weight of the brake and its gear had been used to strengthen the weakened parts better results would have been obtained through the increased strength of the carriage than by the use of the brake. Moreover, under the accepted rules for field guns the introduction of a hydraulic brake between gun and carriage would not generally cause a decrease in the recoil of the carriage; on the contrary, as long as the carriage has no other means of checking its recoil the latter will increase rather than diminish. The chief cause of this is that the hydraulic brake decreases the pressure of the trail during discharge, while the effect of such pressure is chiefly to reduce the velocity of recoil of the system. Under certain circumstances it is, of course, possible, by properly arranging the gun recoil, to obtain not only a decrease of carriage rocoil, but to even overcome it entirely, especially where the pressure in the gun brake is less than the resistance of the soil. But to make this feasible a very considerable recoil must be given to the gun, and this leads to constructions unsuitable for field service. To decrease or overcome the jump the gun recoil, in general, need not be as great as that necessary for overcoming the recoil of the system, but anyway it leads to heavy and lengthy carriages. The Krupp factory made

some of these constructions for purposes of study in order to establish by tests the correctness of its theoretical conclusions. A number of the following models of construction must be considered from this point of view.

For the most important guns built and tested by the Krupp factory, the behavior of the carriage during fire was determined. The recoil and pressure of the trail spades of these carriages were measured for sake of comparison. (See Table III.) The attempt to determine the trail pressure was made by putting three copper cylinders in a housing together, and subjecting them to the pressure of the trail. Although absolute exactness can not be claimed for the figures of the results obtained, still as data for comparison they are worthy of attention.

Among the guns tried was one so arranged by the use of the Krupp chassis carriage that the gun recoil is not in the direction of the axis of the bore, but in a line ascending at an angle of 20 degrees with the horizon. The inclination of the line of recoil serves to return the gun, and is intentionally exaggerated in order that it shall not be lost entirely in case of a deeply-buried trail. Besides this, there is also a light return spring attached. The addition of a slide curved upward would not change the principle, but would further complicate the construction.

A model similar to one of the illustrated carriages, with a rising recoil of 10 degrees, was constructed by the factory in 1883 for an 8.4 cm. field gun, and is now in the gun collection of the factory.

In the other models first tried, the gun recoils in the direction of the axis of the bore. These models are therefore cradle carriages.

In some of these models the limits were pushed in giving the gun a recoil of 18 calibers, that is, 1.18–1.44 m. (41.5–56.75 inches). With this great recoil, springs were no longer sufficient to run the gun forward and the application of compressed air became necessary. It must be repeated that these constructions were only made for experimental purposes and their uselessness for field service was well known.

In order to judge rightly of the results, it must be noted that the tests of the different guns were not made simultaneously nor under the same conditions, as the models were constructed at different times and the tests were made for different purposes. It must be further noted that only a small proportion of the tests made could be tabulated, viz., that of the ordinary effectiveness of the gun and the behavior of the carriage in those points which

were especially observed. With all the guns, numerous other tests with different charges and combinations of muzzle velocity and weight of charge were made.

The important point of Table III is, that in carriages with gun recoil there is, first, a considerable decrease in pressure of trail; second, a braked carriage does not diminish recoil of the piece. Sometimes the jump of a carriage is reduced. Furthermore, the tables prove:

1. Without constraint by the trail spade, the recoil of a braked carriage, with a gun recoil of 1½ to 4 calibers, is generally not diminished, but increased.

2. In the case of an unbraked carriage with gun recoil, the occasionally observed reduction of carriage recoil is, considering the length of the latter, of no importance.

3. Even with minor effectiveness of the gun under No. 1, the gun recoil is insufficient to obviate the carriage recoil.

4. The arrangements for recoil of gun make the carriage heavy.

5. The attachment of a simple brake on the trail makes it possible to effectively stop the recoil of the carriage, but in this case an increased jump of the carriage accrues, unless an extra long gun recoil is permitted.

6. Only with a very long gun recoil in connection with a brake on the trail, a correspondingly heavy weight of carriage, or a minor effectiveness, is it possible to maintain the stability of the piece under fire.

Herewith is proved by tests what was said before on the ground of theoretical considerations. After these direct conclusions, none of which advocate the use of the gun recoil, the following considerations must be mentioned, in spite of the fact that the carriages stood the tests well. The arrangement of the gun recoil is by no means simple; the hydraulic brake demands careful handling and continual attention, things difficult to obtain in the field, especially when experienced men are scarce. For this reason alone the gun recoil does not commend itself for field service. If the filling of the brake cylinder should be neglected the gun might fly backward, not only rendering the piece useless, but endangering the lives of the gunners. In 1892 the factory tested this by partly filling one cylinder of the brake with liquid. The result was that the gun flew backward and the brake was destroyed. The same thing occurs when the device for bringing the gun back into place refuses to work, a thing easily overlooked in rapid fire and in the excitement of battle. Of course the breaking loose of the gun can be obviated by strength-

PLATE II.

2.76-inch rapid-fire gun on field carriage, with axle spade.

A.—Axle spade in traveling position.

B.—Axle spade in firing position.

ening the brake and the appliances connected with it, but this can only be done at the cost of increased weight.

The destructive results of years of hard usage, so deteriorating to the material of a system constructed in this way, have not been determined, and, finally, all such models have the disadvantage that the disabling of the gun recoil apparatus, a comparatively small part of the piece, for instance by the enemy's fire or from other causes, renders the whole gun useless for the time being. This danger increases the longer the recoil and the less simple the devices thereof.

The lessons to be learned from the tests made with gun recoil are not favorable to these constructions.

### AXLE SPADES.

Another means, involving the rigid spur idea, for diminishing the recoil of the piece and at the same time doing away with the necessity of strengthening the carriage, as well as avoiding the tiresome embedding of the trail spade, lay in the creation of a means of control. the bearing point of which was farther forward. The brake in the form of an axle spade, as shown in fig. 1, was subjected to severe tests. These spades were temporarily affixed to the guns. (Plate II and figs. 1 and 2.)

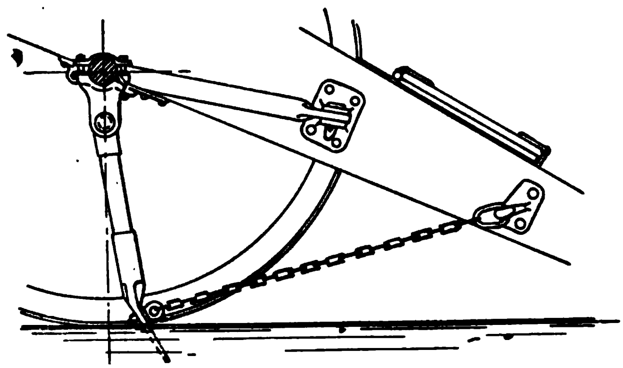


Fig. 1.

A hybrid of the spade brake was applied to an 8 cm. (3.15-inch) piece of L. 30, mounted on a rigid carriage, by transferring the bearing point of the spade stem to the trunnion, which was lengthened for this purpose, as in fig. 2.

PLATE III.

Field carriage with rigid folding spade.

A.—Spade folded up.

B.—Spade in firing position.

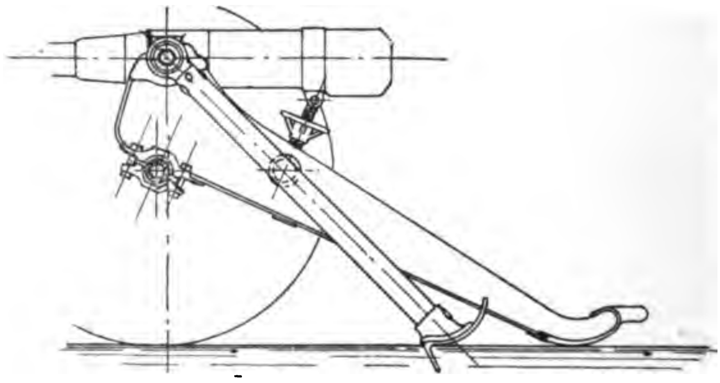


*Fig 2.*

Result of firing with trunnion spade (fig. 2) with:

Weight of system, 1,065 kg. (2,342 pounds);
Weight of projectile, 7 kg. (15.4 pounds);
Muzzle velocity, 570 m. (1,870 feet per second);
Elevation, 2 degrees;
Powder pressure, 2,000 atm. (29,400 pounds per square inch).

A. With braked wheels:

1. On soft ground, the gun jumped 50 cm. from the ground and sank back to the starting point.

2. On heather ground, the rise of the carriage increased to 70 cm.; it sprang back 70 cm.

3. On hard ground the carriage jumped forward 50 cm. in the air and fell back 160 cm. The trail was lifted 40 cm. after the wheels returned to the ground, and remained hanging until the wheel brake was released.

B. Carriage wheels unbraked.

On hard ground the behavior was similar to A 3, with the exception that the trail fell back of itself after the jump, because the wheels were unbraked.

With every round fired under the conditions A and B the lateral deflection of the piece was great.

The axle spade with chains and fixtures increases the weight of the carriage from 50 to 70 kg., and the tests show that apart from the decreased burying of the trail no satisfactory result is obtained, and that, as against the use of the spur, the spade has the disadvantage of greater recoil and greater deflection of the projectile. The recoil is nine times as great as when a spur is

used. The reduced checking power of the spade lies in the fact that, in case of small elevation, instead of being driven into the ground, it is pulled out by the jump of the gun; whereas the burrowing effect of the spur is thereby increased.

When the gun stands on ground sloping to the rear, the axle spades refuse to act, often lying flat on the ground, without pressing in at all.

The attempt has also been made to make the checking by means of the spade less violent by turning it into an automatic contrivance to bring the gun back to place; this was accomplished by replacing the chains, which lead from the end of the spade to the carriage, by a spring connection. As was to be foreseen, the attempt failed, owing to the above-mentioned peculiarity of the working of the spade.

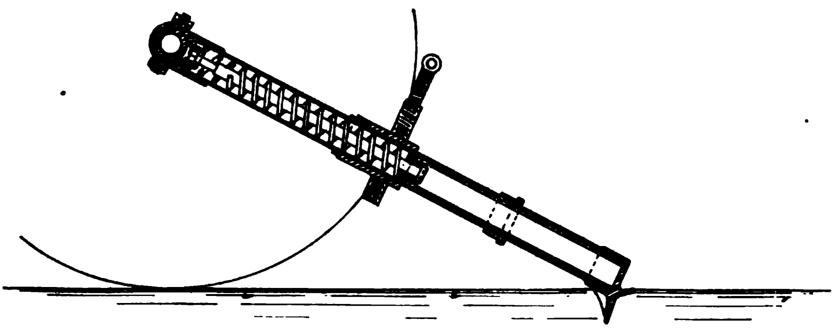


*Fig 3.*

The spade model is however worthy of notice in two connections, first, in case of great elevations, for instance with field howitzers; in the further course of tests it proved rather useful, because the spade prevented the annoying tendency of the howitzer to bury itself in the ground; and secondly, it is the origin of another brake to be discussed later, in which effort was made to combine the advantages of the axle-spade and the "long spring spur" shown in figs. 8*a*, 8*b*, 8*c*.

After the gun recoil and axle spades had been given up, it became necessary to find other means by which to meet the strain on the carriage on the one hand and the recoil and jump on the other. It seems better to make the whole weight of the gun and mount participate in the recoil, because this lessens the work and length of the recoil, and also because in case of injury to the mechanism for checking the recoil, nothing prevents using the carriage as well as the gun, without the brake.

### TELESCOPIC CARRIAGES.

A model which ranks in some respects between the above-mentioned constructions, and which attempts to counteract the harmful effect of the shock on the carriage by producing, when fired, a shortening of the carriage flasks, must be mentioned here. This is the so-called telescopic carriage. The principle is as follows: (See fig. 3.)

The carriage flasks are replaced on either side by two tubes set into each other, the front ones sliding over the rear ones in the recoil. The latter have on their lower end a rigid spur, whereas the front tube bears the weight of all the other parts of the carriage. During fire the main carriage slides back with the

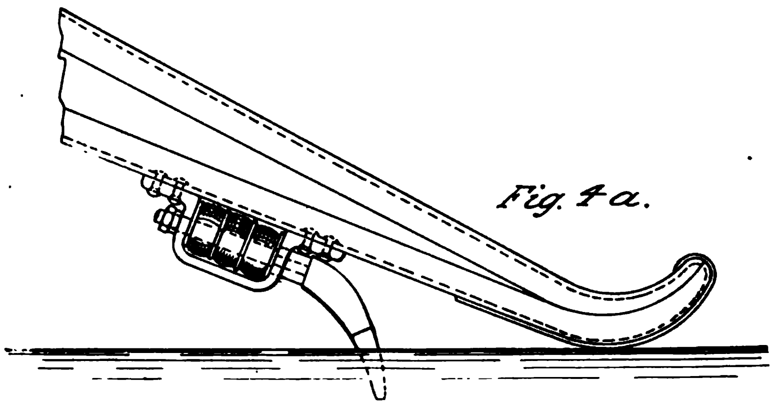


Fig. 4a.

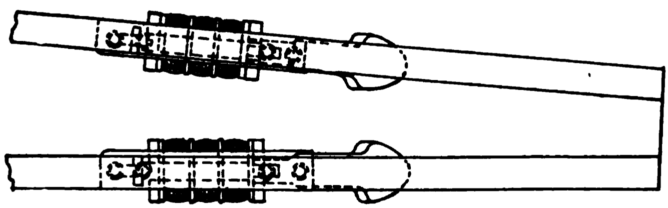


Fig. 4b.

gun and is checked in this motion by the hydraulic or spring brake introduced into the tubes. When the velocity of recoil is reduced to 0, the carriage is forced forward again by the power of compressed air, or by spring power.

A spring power alone is more simple than hydraulic pressure and spring power combined, and besides is sufficient. After several tests the Krupp factory decided in favor of the former, and received for a working plan of this carriage the Imperial German Patent 85,751 on August 28, 1894.

The brake (spring power) serves also as a means of returning the gun. A peculiarity of Krupp's form is that the carriage flasks start from the carriage axle; furthermore the gun is fixed in this, so that the center line of the carriage axle intersects the center line of the carriage flasks and the axis of the bore. The carriage axle is developed into a gun support for a piece with vertical trunnions. The wheels have a diameter twice as great as the firing height. This model, designed in February, 1894, and in accordance with which a gun was completed July 2, 1898, has the advantage over the models with low carriage wheels and different point of application of the line of strain, of a sharper carriage and lower center of gravity and the consequent diminution of the jump of the carriage. The designs of the carriages with low wheels were made in 1893, and an example of this carriage was completed early in the year 1894. Both of these models were constructed merely as experiments. All these telescopic carriages have the common failing that their carriage angle during firing is increased by the shortening of the flasks, and the moment of inertia is reduced; consequently the guns constructed

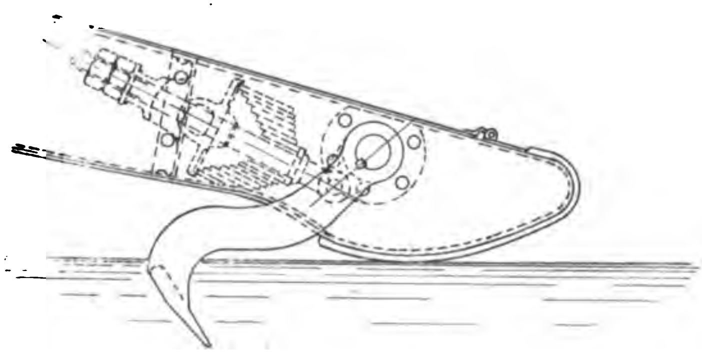


Fig. 5.

according to this plan jump considerably. In the case of injury to the slides or to the exterior of the tubes, which may be caused by the enemy's fire or by transportation and collision of the limber wheels, the mechanism of the telescopic carriages refuses to work, even if hydraulic brakes and air pressure are avoided. On the whole, telescopic carriages have no advantage worth mentioning over simpler constructions. Through the division of the carriage body into two parts, the resistance is diminished in relation to the tendency to bend, which must be met by greater dimensions, which means greater weight.

Further progress of the carriage seemed to lie in the development of the spade on the trail, and the construction of a suitable elastic intermediate member had to be attempted. It was necessary that the firing capacity of the carriage should be maintained in case of the spade's refusal to act, be it because it was broken or because the general character of the ground should not be suitable for its application. The oldest form of elastic method of control on the trail was constructed and tested by the Krupp factory in 1872. The reports and drawings (figs. 4*a* and 4*b*) are contained in the Swiss Artillery Magazine, 1897, pages 223 and 224.

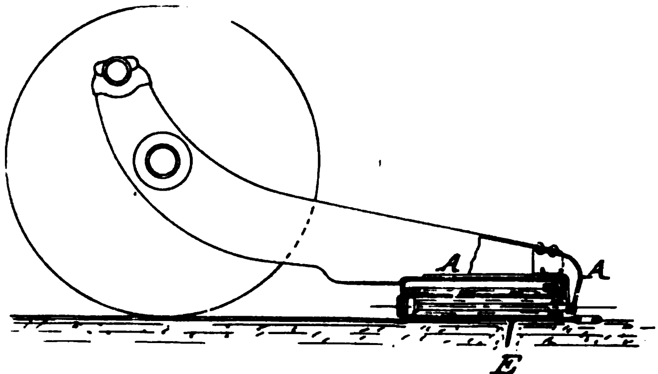



Fig. 6.

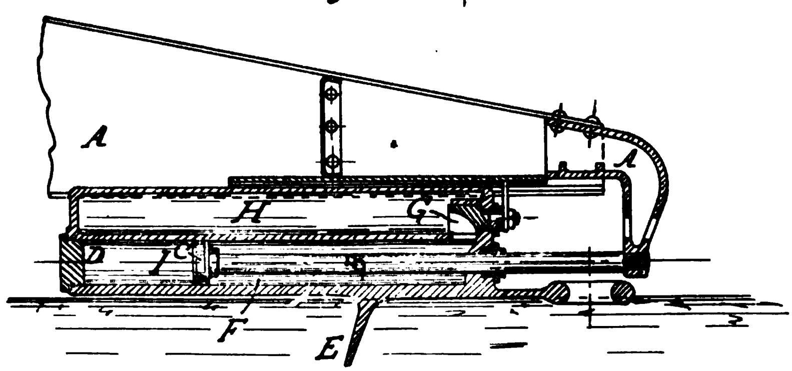



Fig. 7.

In 1892 the elastic spade was applied in another form, at first corresponding to fig. 5, used with a 6.5 cm. (2.56-inch) gun, L. 35. This contrivance (Imperial German Patent 65,948 of March 19, 1892, consists of a spade revolving around a horizontal axis lying in the middle line of the trail, the spade being subjected to a

spring counter pressure. As soon as the resistance reaches a certain intensity the spade gives way. In most cases it does not return the gun to its original position, but in comparison with the rigid spade only increases the ground friction, while reducing the strain on the carriage and the jump. The device is extremely simple, encumbers the trail only slightly, but controls the recoil only imperfectly. The carraige with this model of spade was arranged for a gun with vertical trunnions. (Imperial German Patent 73,012 of December 25, 1892.)

Fig. 8a.

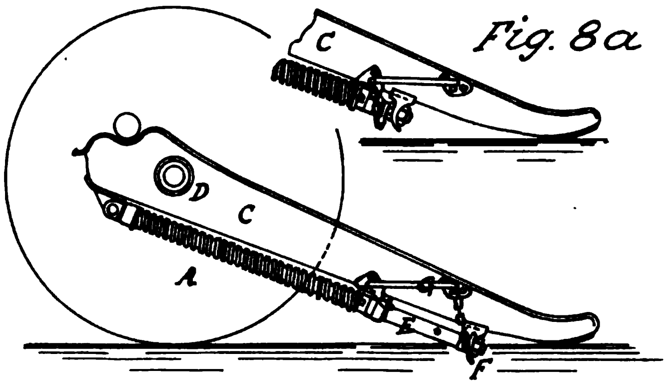


Fig. 8b.

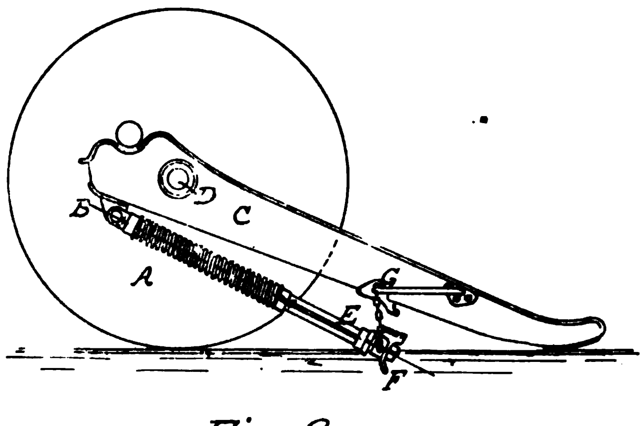


Fig. 8c.

Another simultaneous construction (Imperial German Patent 66,825 of March 19, 1892) consists in the insertion of a hydraulic brake between the spade and the trail (figs. 6 and 7 and Plate VI).*

* See next number of Journal.

The trail *A* provided with slides on the under side is connected by a piston rod, *B*, with a piston, *C*, which is applied above the rigid spade *E*, over which is secured an air reservoir, *H*, covered by the carriage flasks, into which the liquid of space *F* behind the piston is pressed during the recoil past a valve, *G*, so that the pressure of the air in the reservoir is increased. In space *I* of the brake cylinder *D*, in front of the piston *C*, an air vacuum is created during the recoil. When the recoil is ended this vacuum and the above-mentioned compression of air in the reservoir cause piston *C*, and with it the whole gun, to run forward.

FIRING RESULTS.

This carriage has all the drawbacks of carriages which work with air and hydraulic pressure; it seems especially unsafe for field service to rely on a vacuum or attenuated air. Moreover, the construction is heavy, and as it encumbers the trail greatly it necessitates forms of carriage which are undesirable, with extreme forward position of gun supports. Also, it is not fitted for the application of traversing gear, at least not of a sort in keeping with a swinging top carriage, because the oblique backward strain appears dangerous for the piston rod and its packing.

The importance of the construction consists in the fact that, for the first time, it gives expression to the intention of bringing the gun as exactly back into position as possible, after perfectly controlled recoil.

(To be continued.)

# PROFESSIONAL NOTES.

## ORGANIZATION.

### The Organization of the Howitzers with Field and Mountain Artillery.

BY MAJOR T. W. G. BRYAN, R. G. A.

The Indian Frontier War of 1897 and the present war have shown that a howitzer is required to supplement the gun in Field and Mountain Artillery. The gun with its flat trajectory fire prevents the enemy from exposing himself whilst holding a position. He may then keep under cover until the near approach of the attacking infantry, when he again actively defends the position. It is the *rôle* of the howitzer with its curved fire to prevent the enemy from thus utilizing cover in the field.

There are three methods of organizing these howitzers :—

(*a*) Howitzer brigade divisions.

(*b*) A howitzer battery in each brigade division.

(*c*) Four guns and two howitzers in each battery.

These wars have shown, I think, that in our Army (*c*) would have solid advantages over (*a*) or (*b*), though in an army organized for European warfare only, (*a*) or (*b*) might be the best.

It will often happen with us that the artillery in one locality, or directed against one objective will consist of not more than one battery. This is owing to the special conditions under which our peace garrisons are maintained in different parts of the Empire, and to the irregular (*i.e.* non-European) style of warfare in which we are constantly engaged. At such times the need of howitzer fire may be severely felt. This forms a very strong, if not convincing argument for combining howitzers and guns in the same battery, for otherwise it seems difficult, if not impossible, to arrange for both being always at hand when required.

Another great advantage of this system is that there need be no pause in the efficacy of the fire, since the fire direction of both guns and howitzers can be under the same man, viz : the battery commander.

In many cases the guns can do the range-finding for the howitzers, especially if the published range tables are not strictly adhered to, but are corrected locally from time to time from the results of practice. The more heavy and costly ammunition will thus be saved. The Navy use their light quick-firing guns as range-finders for their heavy ones.

I do not think it can be urged that the efficiency of the gun fire, as regards rapid ranging, rate of fire, etc , will suffer by the number of guns in a battery being reduced from six to four. Even with our present equipment the fire effect of four guns is nearly as great as that of six, and the gun of the future will be a quick-firing one.

It is often said that it is very bad to have two natures of ordnance in the same battery. Against this there is the case of the heavy field batteries in India, with four guns and two howitzers each. I served in one for two years and do not remember any difficulty on this score.

It may be objected that the fire of two field howitzers only would not produce a sufficient effect. The reply is that this organization is here proposed

for light and not for heavy field (or position) artillery; that, in the case of a detached battery, two howitzers are better than none, and that when working in Brigade Division, the howitzers may be massed, if the C.R.A. thinks it desirable. Let us however examine the fire effect of a single section of howitzers. The following points regarding field howitzer fire seem to be brought out in recent articles contributed to the *R. A. I. Proceedings* :—

1. Laying for elevation will be, as a rule, if not entirely, with the clinometer. (With a section as a unit, the howitzers will be less frequently on different levels, and the necessary corrections for angle of sight will consequently be simpler).

2. The importance of corrections of deflection for level of wheels, wind, etc., *for each howitzer*; the advantage of having the wheels level, and of hard ground for the wheels and trail-eye.

3. The great advantage of using a ranging point in indirect fire, and of ranging generally with *one* howitzer.

4. Against shelter trenches and concealed targets fire will have to be switched from flank to flank. (This is much simpler when working by sections, especially if howitzers have to be shifted to avoid "danger" angles.)

In all the above points there appears to be a great advantage in simplicity and rapidity, in working with a section only.

In many cases, I think, ranging could be done with two howitzers, when it could not be done with four or six, and errors due to the howitzers ranging further when heated might be avoided.

It appears that with the present 5-inch battery each howitzer can fire, at battery fire, a round in 66.3 seconds; *i. e.* with a section, the rate of fire would be a round in 33.2 seconds. If the howitzer (see below) is made as quick-firing as possible, we may assume that this rate can be increased to a round in 20 seconds or less, *i. e.* three rounds a minute. Assuming the effect of the blast to have a diameter of 30 yards, 90 yards of shelter trench, etc., should be cleared in one minute. I think such a fire, whether directed on troops behind cover, or in trenches, etc., or on single guns in strong emplacements, may be considered to be sufficiently effective.

The above proposed organization for field artillery howitzers is put forward as a suggestion only. It has, of course, no claim to originality. A decisive opinion on this question could only be given by officers who have had practical experience of gun and howitzer employment in South Africa. The teaching of history seems to favor a mixed equipment not only with field, but also with mountain artillery, as, I think, the records of the Panjab Frontier Batteries would show.

The field howitzer should be fully as mobile as the gun. The weight of the shell should be governed by the following considerations :—

(1). It must be capable of being detonated with sufficient effect.

(2). A large enough supply of ammunition must be carried, and therefore as long as (1) is satisfied, the lighter the better.

The 5-inch howitzer appears to be too heavy and could be utilized for heavy field batteries, the great need of which has been confirmed by the present war. A calibre somewhere between 4 and 4.5 inches seems to be the most suitable one.

The mountain howitzer, which with its carriage might consist of six mule loads, should throw a shell of from 15 to 20 pounds or of the minimum weight which may be judged (by experiment) to be effective for the purpose.

Both field and mountain howitzers should be as "quick-firing" as possible,

provided of course that the other more important conditions are satisfied, and some case, and, I think, shrapnel too, should be carried for close ranges.

In the case of mountain artillery, working by brigade division may be considered exceptional. On the other hand, the battery frequently has one of its sections detached. A half-battery of two guns and one howitzer will probably be a useful division on occasion for detached work.

With field artillery the howitzers may sometimes require a separate battery (as well as section) commander. This post might be taken by the captain. This case is unlikely to occur with mountain artillery, since the howitzers, like the guns, must usually be placed on, or close to, the crest line.

I quote in conclusion, some extracts from 'Notes on Artillery dictated by Napoleon at St. Helena. . .' contributed to *R. A. I. Proceedings* about two years ago by F. E. B. L. :—

"The unit of artillery is the division . . . for horse artillery 6 guns; for field 8. . . . It would be better, were it not determined otherwise by the details of artillery, to form a unit of 4 guns, because a battery of 8 guns is already too numerous not to be often divided.

"The 12-pounder remains in reserve to be employed with premeditation by general officers.

"There should be two howitzers * per battery which makes one fourth for them, and one-third for horse artillery . . . this large number of howitzers is necessary to dislodge the enemy from villages, to shatter redoubts, etc. Frederick the Great was the first to augment the number of howitzers."

—*United Service Magazine*, August, 1900.

## ARTILLERY MATERIAL.

### British and Foreign Artillery.

The field guns of most nations at the present time fire projectiles nearly five times as effective in man-killing power as those of the German field artillery in 1870. So said an artillery expert recently.† The splendid services rendered by our field artillery in South Africa and the excellent shooting of our field guns as regards accuracy, have won general admiration, while the close support of our gallant infantry in critical moments by their brave comrades in arms of the artillery, has aroused a sympathy with and enthusiasm for the latter arm, that we may rest assured will never die out. What is then meant by the present outcry against the shortcomings of our artillery? While it is allowed, that the British field gun is excellent of its kind and that there is no doubt of the ability as well as intrepidity of our artillery officers and men, it is said the material is not on a par with those of foreign armies, and that the 15-pounder projectile carried by our field batteries cannot compete with the Russian, French, or German field guns, carrying projectiles weighing from 28 pounds to 16½ pounds. Of course, it is a question of mobility *versus* fire effect. Yet it is stated that the weight behind the team of our field gun is greater than that of foreign guns of greater caliber. Again, there is the question of quick-firing field guns.

* Previous to the introduction of "shell" guns, just before the Crimean War, common shell were not fired from S. B. field guns, but only from howitzers.—*Vide* 'Owen's Modern Artillery,' p. 326.

† See Major May's "Achievements of Field Artillery," and other professional papers.

The French artillery is being rearmed with quick-firing guns, and the Germans have also been given a new gun which is called a quick-firer. The British artillery authorities have been as usual waiting to find out which is the very best of the many systems, and probably also whether our quick-firers cannot be made cheaper at Woolwich, instead of being purchased of Armstrong, Vickers-Maxim, etc. In any case we have hesitated so long that the South African War burst upon us before we were prepared with quick-firing field guns, although our authorities were warned in 1898 by artillery experts that they were as necessary as magazine rifles if our army was to be looked on as able to compete with those of foreign powers. Some prize essays of remarkable ability were contributed to our *Royal Artillery Institution Journal*, showing that our artillery officers were fully alive to the importance of this question. Among the contributors were officers of standing and of recent experience in war. But all that was done was a sort of makeshift by which, towards the end of last year, our field guns were converted into quick-loaders by an arrangement connected with the gun-carriage. This was cleverly designed by Sir George Clarke, and appeared the most economical plan. Whether it would have been true economy to purchase outright from British firms, or, if they could not supply sufficient, from foreign firms, the number of modern quick-firing field guns required is a question worth going into. Volunteer field artillery, as well as guns of position, are required for the defence of the United Kingdom, and if our field artillery had been re-armed, the existing field artillery guns might have been utilized for the Volunteers. The table below, extracted from German reports in 1898, gives particulars showing some of the chief characteristics of quick-firing field guns at that date, but of course progress has been made since. The Vickers-Maxim, the Swiss guns, and the Swedish guns are omitted from the table. The Creusot quick-firing guns are probably the same as those used by the Boers.

Nordenfelt.—Caliber, 2.95 ins.; weight of shell, 14 lbs. 4 ozs.; length of gun, 6 feet, 7 in.; weight of gun, 6 cwts.; weight of gun limbered up, 31 cwts. 3 qrs.; muzzle velocity, 1,640 ft. per sec.; number of rounds in limber, 50; number of bullets in shell, 159; weight of bullets, 7¼ drs.

Cail.—Weight of shell, 15 lbs. 11 ozs.; length of gun, 7 ft. 3 ins.; weight of gun, 6 cwts. 2 qrs.; weight of gun limbered up, 27 cwts. 2 qrs.; muzzle velocity, 1,722 ft. per sec.: number of rounds in limber, 36.

Canet (long).—Calibre, 2.95 ins.; weight of shell, 11 lbs. 6 ozs.; length of gun, 7 ft. 10 ins.; weight of gun, 6 cwts. 2 qrs.; weight of gun limbered up, 30 cwts. 2 qrs.; muzzle velocity, 1,968 ft. per sec.; number of rounds in limber, 35.

Hotchkiss.—Calibre, 2.95 ins.; weight of shell, 15 lbs. 1 oz.; length of gun, 7 ft.; weight of gun, 7 cwts.: weight of gun limbered up, 31 cwts.; muzzle velocity, 1,738 ft. per sec.; number of rounds in limber, 48.

Creusot.—Calibre, 2.95 ins.; weight of shell, 19 lbs. 1 oz.; length of gun, 8 ft. 2 ins.; weight of gun, 6 cwts. 2 qrs.; weight of gun limbered up, 34 cwts.; muzzle velocity, 1,837 ft. per sec.; number of rounds in limber, 36.

Krupp.—Calibre, 2.95 ins.; weight of shell, 16 lbs. 7 ozs.; length of gun, 7 ft.; weight of gun, 7 cwts. 3 qrs.; weight of gun limbered up, 34 cwts. 3 qrs.; muzzle velocity, 1,640 ft. per sec.; number of rounds in limber, 30; number of bullets in shell, 250; weight of bullets, 6 drs.

Armstrong (Elswick).—Calibre, 3 ins.; weight of shell, 13 lbs. 11 ozs.; length of gun, 7 ft. 10 ins.; weight of gun, 7 cwts. 4 qrs.; weight of gun

limbered up, 36 cwts. 1 qr.; muzzle velocity, 1,970 ft. per sec.; number of rounds in limber, 36; number of bullets in shell, 185; weight of bullets, 7 drs.

The 12 c.m. (4.7 in.) and 15 c. m. (5.9 in.) Creusots are field howitzers used as position guns. The 4.7 in. field-howitzer is about 5 feet long. It fires a 44 pound shell, and has a muzzle velocity of 1181 f. s. It is, therefore, not a superior gun to the British 5 inch field-howitzer, which is an excellent weapon. Its Lyddite 50 pound shells have proved effective, and it is not understood why, its excellence having been proved in the field at Omdurman, more of these howitzers were not ready, and three brigade divisions sent out with the Army Corps instead of dribbling out single batteries afterwards, as the necessity for them must have been foreseen. Even now there are not sufficient of these, so some Armstrong field-howitzers of 4.7 calibre carrying a shell of 45 pounds weight are being ordered. The inconvenience of having different sorts of howitzers and ammunition in Brigade Divisions is evident. Perhaps, however, they are to be used for the siege train. The siege train howitzers are 6-inch breech-loaders, eight of these and four 4.7-inch quick-firing guns form the siege train at present sent out to South Africa. These howitzers fire a shell weighing 122½ pound, and are formidable weapons.

The armament of our coast batteries undoubtedly leaves much to be desired; and if the great public interest which has been shown in this vital question of our armament as regards our artillery, as evinced by the many able letters in the *Times* on the subject, leads to a searching inquiry as to the cause of the insufficiency of our artillery material for the defence of our great Empire, and that inquiry be conducted without prejudice, free from the self-satisfied optimism of officials on the one side, and from the pessimistic opinions of possibly interested manufacturers on the other, and, above all, if prompt action be taken thereon to re-arm our artillery with weapons of the most efficient kind irrespective of cost, so that we may be able to take the field at the shortest notice anywhere for the defence of our wide-spreading responsibilities, the public voice will not have spoken in vain. As far as they go our 15-pounder field-guns are good and shoot straight, and Sir George Clarke's converted carriage is said to have given satisfaction on service so far. The rate of fire obtained has been about six rounds per gun per minute, but the extreme range for shrapnel is 4,000 yards, and with common shell about 5,000 yards. No common shell were taken out by the batteries to South Africa. People have been asking why no guns of position were sent out. Have we any modern guns of position? They are not mentioned among the guns of an army corps, nor are they to be found in the organization tables of foreign armies. They are used for special purposes of defense. Whether they should be manufactured and used as well as our 5-inch howitzers is a question for artillery experts. Hitherto we have had too many kinds of guns. What is wanted is guns thoroughly up to date and plenty of them.

—*The Army and Navy Gazette*, April 7, 1900.

## MILITARY HYGIENE.

### Malaria and the Mosquito Theory.

Laveran's discovery of the parasite which causes malaria was a pronounced step forward in our knowledge of the disease, but not by any means so radical and imdortant as the development of the fact, years before, that the bark of the cinchona tree was a definite enemy to the malarial poison.

Daniel Drake, in the earlier days of our medical history, was a persistent

student of this almost universally distributed disease, and in his work published years ago with the title "Autumnal Fevers of the Mississippi Valley" he presented contributions which stand to-day as almost classical.

The earlier as well a later students, observers and writers on the subject have favored the thought that the mosquito was in some manner closely related to malaria. As far back, in fact, as the beginning of the Christian Era, writers touched upon the relation of the mosquito to malaria, and among the early American writers along these lines may be mentioned Mitchell, of Philadelphia; Nott, of New Orleans (in 1848); and King, of Washington (who published a pamphlet in 1883), giving numerous plausible reasons for sustaining the theory.

The mosquito theory has been continuously studied, not only by Laveran in 1891 (he who discovered the malarial plasmodiun); Pfeiffer, who evolved the specific germ of la grippe; as well as Bignani, but the great Koch, whose name will ever be associated with the practical demonstration of the cause of tuberculosis, has for several years devoted much time and study to this branch of germ life.

A recent writer observes:

"The fact that the malarial parasite is paludal in its habits, and that the mosquito is a blood sucker and also paludal in habit, is extremely suggestive of this connection. The idea, however, did not take definite form until Patrick Manson, in his Goulstonian lectures, delivered in 1896, set forth a definite hypothesis, based on certain well-established facts, namely, that the malarial parasite possessed a flagellating phase, that this phase is developed from the mature parasite, that it is evolved only when the parasite is outside the human body, that the flagella, when formed, break away from the parent parasite, and that, when free, the flagella were capable of living as independent organisms. He was thus led to believe that the flagella was the extra-corporeal phase in the life history of the parasite. As it was impossible for the latent form in which this organism originated to escape from the human body by itself, it was necessary to invoke the assistance of some outside agency. The most probable agent was the mosquito, and Manson supposed that the flagellated body was sucked, in its latent form, into the stomach of the mosquito and developed therein. The flagellæ then broke away from the central sphere, and in virtue of their locomotive power traversed the blood in the mosquito's stomach, penetrated the stomach wall, entered some cell and started the "outside-of-the-body" life of the malarial parasite. Manson still believed, however, that malaria could be air or water borne, for he supposed that on the death of the mosquito the parasite was liberated, and either inhaled from the air or carried into the system in drinking water."

All these theories regarding malaria are most interesting, but the facts of most vital import are those related to the cure of the disease.

The æstivo-autumnal parasites are energetically at work everywhere now. Reports from South American countries are confirming definitely the fact, already observed and announced by many eminent medical men throughout America, that the synthetic product of organic chemistry, phenalgin, is of great value in fighting these parasites. From five to fifteen grains of phenalgin may be given every two to four hours. Inside of forty-eight hours the average attack of malaria will be aborted. Not only will this course of treatment be antagonistic to the poisons of malaria, but will soothe and relieve the distressing symptons accompanying it, reducing the fever, allaying the aches and pains and causing a restful sleep.

Nowhere does malaria assume a more virulent form than in the tropical countries, and when we have such pronounced results in favor of phenalgin as on effective malarial germicide it is convincing. Following the above course for adults ten grains of quinine (in capsules) accompanied by the same amount of phenalgin may be given at bedtime for two or three nights, after which a tonic composed of the following may be given three times a day for a week or ten days, viz. :

| | |
|---|---|
| Quinine Sulphate | ½ dram. |
| Fowler's Solution | 1 dram. |
| Water | 6 ounces. |
| Glycerine | 2 ounces. |

Shake. Dose : A tablespoonful at meal times.

—*Gaillard's Medical Journal.*

# BOOK REVIEWS.

**Bonaparte en Italie, 1796. Félix Bouvier. Paris: Librairie Léopold Cerf. 1899. Pages 748. Price: 7 fr. 50. Ouvrage Couronné par l'Academie Française.**

The French Academy has seen fit to confer on the author of this work the Thérouanne prize of 1900, thus marking it as a masterpiece in its line of thought. It aims to reconstruct in a systematic and impartial manner the epoch it covers, basing its record entirely on the official documents bearing on the period and its events, and quoting these in their entirety.

Napoleon himself has taken great pains to describe his victories in Italy, and it may appear audacious for any one else to attempt it, but it must be remembered that his memoirs were dictated at Saint Helena, far from the original documents preserved in the archives in Paris, and with only his own bulletins as a basis for his story. These bulletins, issued in each case immediately after the affair they refer to, abound in errors, in intentional deceptions, in omissions and in exaggerations. One of his most faithful admirers has referred to them as resembling extracts from the Iliad. Napoleon's account is not history. Although true in general outline, it is entirely unreliable in the details. Aside from the lack of documentary evidence, it is evident that Napoleon wrote so as to present the facts as he desired posterity to view them. Even his defeats, as at Ceva and San-Michele, he knew how to envelop in his victories of the day before and the day following. And any feat of arms, like Lodi, for example, he clothed with a poetic halo that made it appear almost superhuman.

The historical works since Napoleon's day have merely followed his account, no author having had the temerity to make public the mistakes in the original version.

Today, however, the documents available enable the historian to review the events calmly and in an impartial spirit, and this has been the great task of the present author, who has given us a work remarkable for its clear and spirited presentation of Napoleon's greatest campaign, founded entirely on the official documents, and therefore as accurate as history can be,—that campaign in which were hidden the germs of the great generals and marshals of France: Masséna, Berthier, Angereau, Lannes and Murat.

The history opens with the second of March, 1796, when Bonaparte was appointed commander-in-chief, and enters at once on a full description of the army, its character, strength and organization, followed by an account of its staff. Before taking up the campaign proper a very interesting chapter is devoted to the previous history and the then condition of Italy. The separate events of the campaign are next discussed in succession beginning with the various plans of campaign proposed, and the first skirmishes and reconnaissances, and ending with the grand review in Milan on the 19th of May.

The differences in the new account as compared with the old accepted version, are well marked, but we can call attention to but a single one here. Bonaparte and his successors describe the passage of the bridge of Lodi in these terms: "The grenadiers, in closed column, crossed the bridge at a run in a few bounds, and were over on the other side in the twinkling of an eye,

*without sustaining any losses.*" The true account reads: The column, advancing in closed ranks, received such a heavy fire that it hesitated and stopped; then took up the advance again, but instinctively in dispersed order, and had it not been for some skirmishers who threw themselves into the bed of the Adda and drew the Austrian fire on themselves, the attack on the bridge would probably have failed. The detailed account as here presented, while lacking the dramatic element of Napoleon's version, is far more natural and to a military man evidently truer.

The entire work is a new departure in history which deserves full encouragement. Ropes has given the world the true account of Waterloo, Sloane has searched the original documents in Florence and elsewhere for new data on Napoleon's life, especially his youth, and Bouvier in the present volume has given us the plain and simple facts about his first campaign. All of these have brought us nearer the truth, have thrown new light on parts of the history of the times, yet none have dimmed the lustre of the star that led France on her career of conquest. Closer study serves merely to emphasize his remarkable genius.

Aside from its historical value this work of Bouvier possesses literary merit of a high order, which should place it in the foremost rank of recent histories.

J. P. W.

**Paul Krüger und die Entstehung der Südafrikanischen Republik. J. F. Van Oordt, B. A. Basel: Benno Schwabe, 1900. Pp, 1234. 2 volumes. Price, unbound M. 15, bound M. 18.**

There has been a demand for a reliable account of the life of Paul Krüger for some years past, and the late events in South Africa have made the call for such an account almost imperative. Undoubtedly the President of the Transvaal Republic has attracted much public interest, and this not only because of the great events transpiring in his state, but also because of his own remarkable history and the strong lines in his character; and a history of this statesman is inseparably connected with that of the development of the South African Republic.

The author who here presents a life of the great Boer is an Afrikander by birth, has studied his subject at first hand, was well acquainted with the friends and contemporaries of President Kruger, and had access to the archives in Pretoria for the foundation of his work.

The latter is divided into two parts. The first part treats of the great trek of the Boers out of Cape Colony, the endless wars of the emigrants with the natives (Zulus, Basutos, Kaffirs, etc.), and the development of the state up to 1886. The second part continues the history to the present time. Throughout the two volumes the character of the great Boer is set forth in its various stages of growth and evolution.

No other historian of this statesman has had such advantages as Dr. Van Oordt. In the first place, his father, Dr. J. W. G. Van Oorth, was a historian before him, and assisted him in his work; moreover, Dr. J. W. Leyds, the Archivist of Cape Colony, Dr. J. W. Leibbrandt and many others, as well as the President himself, gave aid freely, and Edmund Powell, the editor of the *Cape Argus*, placed that publication at the author's disposal, to assist him in presenting the British views on the various questions considered.

The account of the Kaffir wars is stirring and dramatic in the extreme, and the severe trials to which the Boer leaders were subjected in those early days are graphically presented. The political history is set forth fairly and fully,

and with a confidence that could only come from perfect familiarity with the subject, and its study is of great interest. The history of the Jamieson Raid, the domestic and foreign policy of Krüger, and the condition of the Republic just before the present war, are set forth with a detail and a completeness nowhere else to be found.

The work is well printed on fine, heavy paper, in clear type. It was originally issued in fifteen parts, but is now published in two bound volumes. As a history it is a valuable addition to the material which enables us to judge of the differences between England and the Transvaal, since it presents the views of a native, associated with those high in the counsels of the Boer state, in marked contrast to the English views commonly expressed in English journals, as well as to the highly prejudiced continental views found in French and German periodicals, for the author, although himself an Africander, and worshiping his hero, tries to present a fair view of the British side of the question as well. J. P. W.

**Air, Water, and Food, from a Sanitary Standpoint. By Ellen H. Richards and Alpheus G. Woodman, Instructors in Sanitary Chemistry, Massachusetts Institute of Technology. New York: John Wiley and Sons, 1900.**

The three essentials for healthful human life are here treated from a sanitary standpoint, calling into requisition the chemist's aid, the purpose being to educate the individual so as to make up the mass of public opinion which shall support the city or state in carrying out sanitary measures.

Each of the three commodities is dealt with in its relation to the needs of daily existence: *first*, as regards its normal composition, *secondly*, as to natural variations from the normal, *thirdly*, as to artificial variations. Thus, in the case of air, its composition and impurities are first considered, then the subject of ventilation, and finally the various analytical methods for determining its exact composition including impurities. In the case of water, its source and properties from the householder's standpoint are first discussed, then the problem of safe and acceptable water and the interpretation of analysis, from the chemists' standpoint, and finally the various analytical methods in use. Food is treated under the heads: composition, source, dietaries, adulteration and analytical methods.

The analytical methods are the latest and best, are given clearly and fully, and constitute the mass of the work. The descriptive chapters introducing the various subjects and connecting the chemical parts are of great interest to the general reader and furnish rich food for thought. The work is in reality a chemist's handbook of analysis of air, water and food, with a few essays of a general descriptive character added. A good bibliography of the subjects treated is added in the appendix. J. P. W.

**The Boers in War. Howar C. Hillegas. New York: D. Appleton & Co. 1900. Price, $1.50.**

This work of the author of *Oom Paul's People* presents the story of the British-Boer War, as seen from the Boer side, and gives a description of the men and methods of the Republican armies. Its aim is to show the Boer army, country and people as they existed prior to the British occupation of Pretoria, and to represent men and matters as they presented themselves to the eyes of an American.

The author visited all the principal laagers and commandoes on the various frontiers, consequently he can speak with some authority.

The preliminary chapters are devoted to a description of the country and the Boer army: its composition, organization and military system—a most interesting picture of a remarkable army. The author is evidently at home in his subject, and draws a very clear outline of the character and composition of this army of burghers, with some good sketches of their peculiar state of discipline and ideas of military duty, discipline and subordination.

One chapter is devoted to the war presidents, another to the Boer generals, and a third to the Boer women in the war. The individuals, who form the subjects of these sketches, are each and all presented to the reader in strong colors that mark the essential lines in their lives, their characters, and their military qualities.

The author claims that "personal feeling has been eliminated," but even the casual reader can readily see that he favors the Boer side of the struggle. Still, as he states, the Boers' apparent faults have been portrayed as truthfully as their good qualities, and on the whole the book is fair to both sides, although occasionally exaggerating the relative numbers on the two sides, and often exalting the prowess of the Boer, at the expense of the English soldier.

The book is handsomely illustrated by interesting pictures of the Boers and Boer life, and forms a valuable addition to the personal side of the literature of this war. J. P. W.

**The Campaign of 1815. Ligny: Quatre Bras: Waterloo. By William O'Connor Morris, Sometime Scholar of Oriel College, Oxford. London: Grant Richards. New York: E. P. Dutten & Co. 1900. Pp. 420. $5.00.**

The author of this new work on the brief but great campaign of 1815, is well known to the literary world, and has also produced a number of excellent works more purely military in character. The present volume is dedicated to Captain A. T. Mahan, U. S. Navy, and its object is stated to be "to combine a succinct but complete narrative of the campaign of 1815 with a careful running commentary on its military operations," and thus to satisfy the general reader as well as the scientific student of war. This purpose has been accomplished so satisfactorily that the work is unique as a complete history of this campaign, fully up to date, thorough, accurate and entertaining, written in the author's best style, his excellent command of the English language fully displayed.

The author has made use of the latest and best works bearing on this campaign, viz: Ropes' *Campaign of Waterloo*, the recent work of H. Houssaye on Waterloo, Lord Wolseley's *Decline and Fall of Napoleon*, and the *Memoirs* of of Barras, Metterwich and others, besides many other works, especially original sources, and presents a perfectly fair and unprejudiced view of this remarkable epoch.

The French writers, as a rule, have exaggerated the Napoleonic legend of 1815; a large majority of the English writers have followed the Wellingtonian legend, far more untrue than the Napoleonic; and German writers have been equally biassed. The work before us aims to dissipate all these false conceptions, and to supply omissions in the account relating to the D'Erlon incident and the movements of Grouchy.

In the opening chapter is given a very accurate picture of the political situation before the return of Napoleon and at the opening of the campaign, a necessary preclude to a full understanding of the military events.

The four points in this campaign, which have always been subjects of dispute, and yet which are of vital importance in judging the strategy of the

campaign, and its tactical execution, viz: the health and physical state of Napoleon, Ney's conduct, the D'Erlon incident, and Grouchy's movements, are considered here with more than usual fullness, and the account given is more complete and satisfactory than any yet published. It is a real pleasure to see with what fine discrimination the author takes up the different views that have been presented on these points, and to have clearly set forth the truth about each one of them. It is particularly pleasant to have such fairness from an English pen, and it is remarkable how completely the author has freed himself from all prejudice in favor of his own countryman, Wellington, and, without detracting from the greatness of that soldier, has nevertheless painted with a master hand the last brilliant conception of the world's greatest military genius, the execution of which failed only because his lieutenants, Reilly, D'Erlon, Ney and Grouchy, failed him.

The present volume is the most complete—in fact the only *complete*—account of this campaign, and for careful study, accuracy, graphic description and historic fairnes it stands unrivalled. J. P. W.

**The Campaign of Königgrätz, A Study of the Austro-Prussian Conflict in the light of the American Civil War. By Lieut.-Col. Arthur L. Wagner, Assistant Adjutant General, U. S. Army. Second Edition, 1899. Kansas Citv, Mo.: Hudson-Kimberly-Publishing Co.**

The first edition of this work appeared in 1889, and at once established the reputatian of the author as a keen student of tactics, The edition was soon exhausted, and the demand for copies since then has been snfficient to warrant the production of a new and revised edition. In the latter the plates (maps) are bound separately, which is a great improvement.

The author has taken the trouble to go over the battle fields in person, and hence his idea of the topography has been obtained at first hand. The maps are clear, accurate and adequate.

The work is an excellent strategical and tactical study, and is published in such convenient form that it constitutes a very handy text-book for the study of this campaign, which, coming as it does so soon after our own civil war, furnishes an interesting subject for comparison,—one of the special points which the author has developed.

Colonel Wagner, since the publication of the first edition, has obtained an international reputation as a writer on tactics and strategy, and this new edition of his account of the Campaign of Königgrätz is the best purely military study of the subject extant. J. P. W.

**Preparatory Battle Formations. Major-General H. M. Bengough, C. B. Second Edition (Revised). London: Gale and Polden Ltd. One Shilling.**

The purpose of this pamphlet is to present a system of infantry formation suitable for advancing to the attack of a position, or moving in the near neighborhood of an enemy, but not under infantry or close artillery fire.

The principle involved is that of *small columns* composed of sections, platoons, or companies, moving by fours at any required intervals.

The campaign in South Africa has strengthened the author in his conviction that some such system must soon replace the antiquated formations now in use.

The subject is one of great interest to the military world, and this booklet, already in its second edition, deserves careful study and consideration.

J. P. W.

**Recueil des Travaux Techniques des Officiers du Génie de l' Armée Belge. Tome II, 1900. Bruxelles: 46 Rue de la Madeleine.**

We have had occasion to call attention to the excellent character of the articles in the first volume ot this publication. The present (second) volume is similar in contents. It will be sufficient here to note a few of the articles of special interest to us, and to give the name of the author of each: both will speak for themselves in indicating the value of the articles in each case.

*Two questions relative to the tactics of the attack and defense of fortifications.* V. Deguise, Captain of Engineers, Professor of Fortification at the Military Academy.

*The Resistance of Concrete Constructions lo the Fire of Artillery.* E. Tollen, Captain of Engineers, Assistant Professor of Fortification at the Military Academy.

*A Military Field Telephone and Telegraph Instrument.* P. Giron, Lieutenant of Engineers. J. P. W.

**Projet de Recrutement de l'Armée Belge. Par le Colonel Van Bever. Bruxelles· J. Lebèque it Cie.**

The question of military service in Belgium has been a very active one for some time and lately even General Brialmont published his views on the subject. The pamplet of Colonel Van Bever contains a proposition for a new system embodying the following points:

1. Examination of men who have arrived at the proper age to enter the militia.
2. Drawing lots among those found available for service, with a right to exchange.
3. Voluntary enlistments in the army.
4. Creation of a "Volunteer Reserve."
5. Admission of volunteers of the active army *only*, to the salaried positions in the commune, the province or the state.
6. Abolition of the *Rénumération* (an institution peculiar to Belgium, dating from 1875, by which the Militiaman is entitled to a contigent amunity of 150 francs, after attaining the age of 55 years), using the money set aside therefor to pay the civil employés of the accessory services of the army, and to build up professional schools for the latter.

Besides developing this plan, the author incidentally discusses the laws of recruitment of the other principal nations. J. P. W.

## BOOK NOTICES.

[These books will be fully *reviewed* as space becomes available.]

**Despriptive General Chemistry.** A Text Book for short course. By S. E. Tillman, Prof. of Chemistry, etc., U. S. Mil. Acad. Second Edition. New York: John Wiley & Sons. 1899.

**A Text-Book of Important Minerals and Rocks.** With tables for the Determination of Minerals. By S. E. Tillman, Prof. of Chemistry, Mineralogy and Geology, U. S. Mil. Acad. First Edition. New York: John Wiley & Sons. 1900.

**The Spanish Verb with an Introduction on Spanish Pronunciation.** By 1st Lieut. Peter E. Traub, 1st U. S. Cavalry, Asst. Prof. of French at the U. S. Mil. Acad. New York: American Book Company.

**Great Commanders: Commodore Paul Jones.** By Cyrus Townsend Brady. New York: D. Appleton & Co. 1900. Pp. 480.

**The Story of the West: The Story of the Soldier.** By Brevet Brigadier-George A. Forsyth, U. S. Army (Retired). New York: D. Appleton & Co. 1900. Pp. 389.

**A Second Supplement to a revised account of the Experiments made with the Bashforth Chronograph to find the resistance of the air to the motion of projectiles.** Francis Bashforth, B. D. Cambridge: Printed at the University Press. 1900. *Price One Shilling.*

**Die Ueberhitzung und ihre Praktische Verwerthung von Oberingenieur A. Rieder**

**Deutsche Land und Seemacht daheim und in den Kolonien.** Berlin: Militär-Verlagsanstalt. Per Quarter 6 Marks.

A new illustrated military and naval fortnightly publication has appeared under the above title, which promises to be interesting and valuable. The second number of this periodical contains articles on The Sea Power of Germany, the German Grand Maneuvers, 1900, China, Colonial Questions, and the new Steamer line from Hamburg to Northern Brazil.

**Alloys of Iron and Nickel.** R. A. Hadfield. Inst. Civil Engs., London.

**Untersuchungen über die vibration des Gewehrlaufes** von C. Cranz und K. R. Koch. Munich, 1900.

**Outlines of a System of Graphic Ballistics based on Krupp's Tables.** Prof. Carl Cranz, Stuttgart. Reprinted from *Zeitschrift für Mathematik und Physik*, Leipzig.

**Théorie et Tracé des Freins Hydrauliques par M. E. Vallier.** Extrait de la *Revue de Mécanique*, 1899–1900. Paris: Vve. Ch. Dunod, Editeur.

**Theoretische und Experimentelle Untersuchungen über die Kreiselbewegungen der rotierenden Langgeschosse während ihres Fluges.** Professor Dr. Carl Cranz in Stuttgart. Dresden: B. G. Teubner. 1898. Reprinted from *Zeitschrift für Mathematik und Physik.*

**Ueber die Explosionsartige Wirkung moderner Infanteriegeschosse.** C. Cranz and K. R. Koch. Leipzig: Johann Ambrosius Barth.

# INDEX TO CURRENT ARTILLERY LITERATURE.

## PERIODICALS CITED.

Abbreviations employed in index are added here in brackets.

All the periodicals are preserved in the Artillery School Library, Fort Monroe, Virginia.

### ENGLAND.

**Aldershot Military Society.** *Occasional.*
*Aldershot. Copies* 6*d each.*

**Arms and Explosives.** [*Arms and Ex.*] *Monthly.*
*Effingham House, Arundel Street, Strand, London, W.C. Per year* 7*s.*

**Army and Navy Gazette.** [*A. and N. Gaz.*] *Weekly.*
3 *York Street, Covent Garden, London. Per year* £1 12*s* 6*d.*

**Canadian ilitary Gazette.** [*Can. Gaz.*] *Fortnightly.*
*Box* 2179 *Montreal, Canada. Per year* $2.00.

**The Engineer.** [*Eng.*] *Weekly.*
33 *Norfolk Street, Strand, London. Per year* £2 6*d.*

**Engineering.** [*Eng'ing.*] *Weekly.*
35-36 *Bedford Street, Strand, London, W.C. Per year* £2 6*d.*

**Journal of the Royal United Service Institution.** [*Jour. R.U.S.I.*] *Monthly.*,
22 *Charing Cross, Whitehall, London, S.W. Per year* 24 *s.*

**Journal of the United Service Institution of India.** [*Jour. U.S.I. India*] *Quarterly.*
*Simla, India. Per year* $2.50.

**Photographic Journal.** [*Photo. Jour.*] *Monthly.*
66 *Russell Square, London.*

**Proceedings of the Institution of Civil Engineers.** [*Proceedings I.C.E.*]
25 *Great George Street, Westminister, London.*

**Proceedings of the Institution of Mechanical Engineers.**
[*Proceedings I.M.E.*] 19 *Victoria Street, Westminister, London.*

**Proceedings of the Royal Artillery Institution.** [*Proceedings R.A.I.*] *Monthly.*
*Woolwich, England.*

**Professional Papers of the Corps of Royal Engineers.**
[*Prof. Papers Corps Royal Eng'rs.*]
*Chatham, England.*

**Review of Reviews.** [*Rev. of Rev. Austral.*] *Monthly.*
169 *Queen Street, Melbourne, Australia. Per year* 11 s. 6 d.

**Transactions of the Canadian Institute.** [*Trans. Canadian Inst.*]
58 *Richmond Street, Toronto, Canada.*

**Transactions of the Canadian Society of Civil Engineers.**
[*Trans. Canadian Soc. C.E.*]
*Montreal, Canada.*

**Transactions of the East of Scotland Tactical Society.**
[*Trans. E. of S. Tactical Soc.*]
51 *Hanover Street, Edinburgh, Scotland.*

**Transactions of the Institute of Naval Architects.**
[*Trans. Inst. Naval Architects.*]
5 *Adelphi Terrace, London, W.C.*

**United Service Gazette.** [*U. S. Gaz.*] *Weekly.*
10, *Wine Office Court, Fleet Street, London, E. C. Per year* £1 10 *s* 6 *d.*

**United Service Magazine.** [*United Serv. Mag.*] *Monthly.*
13 *Charing Cross, S. W. London. Per year* 27 *shillings.*

## FRANCE.

**Armée et Marine.** [*Armée et Mar.*] *Weekly.*
3 *Place du Théatre Français, Paris, France.*

**Le Génie Civil.** [*Génie C.*] *Weekly.*
6 *Rue de la Chaussée d'Antin, Paris. Per year* 45 *Fr.*

**Le Livre Militaire.** [*Livre Mil.*] *Monthly.*
6 *Rue de la Chaise, Paris. Per year* $1.00.

**La Marine Française.** [*Marine F.*] *Semi-monthly.*
26 *Rue de Grammont, Paris. Per year* 30 *Fr.*

**Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils.** [*Ingénieurs Civils.*] *Monthly.*
10 *Cité Rougemont, Paris. Per year* 36 *Fr.*

**Mémorial des Poudres et Salpêtres.** [*M. Poudres et S.*] *Quarterly.*
*Quai des Grands-Augustins,* 55, *Paris. Per year* 12 *Fr.*

**Le Monde Militaire.** [*Monde.*] *Fortnightly.*
6 *Rue de la Chaise, Paris. Per year* 8 *Fr.*

**Revue d'Artillerie.** [*R. Artillerie.*] *Monthly.*
5 *Rue des Beaux-Arts, Paris. Per year* 22 *Fr.*

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**Journal of the Association of Engineering Societies.** [*Eng. Soc.*] *Monthly*
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